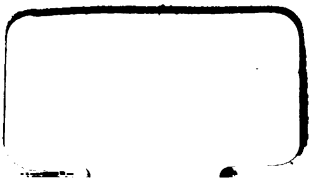

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A. H. SABIN, M.S., D.Sc.

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HOUSE PAINTING

GLAZING, PAPER HANGING, AND WHITEWASHING

A BOOK FOR THE HOUSEHOLDER

BY

ALVAH HORTON SABIN, M.S., D.Sc.

MEMBER OF THE AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY, THE AMERICAN SOCIETY FOR TESTING MATERIALS, THE SOCIETY OF ARTS (LONDON), ETC., LECTURER IN NEW YORK UNIVERSITY

SECOND EDITION, REVISED AND ENLARGED

NEW YORK

JOHN WILEY & SONS, INC.

LONDON: CHAPMAN & HALL, LIMITED

1918

First Edition Entered at Stationers' Hall

Stanhope Press
F. H. GILSON COMPANY
BOSTON, U.S.A.

PREFACE TO THE SECOND EDITION

In this edition a few rather unimportant corrections have been made; and some additional matter has been added, to guide the amateur who wishes to mix his own paint. Anyone can do this for simple and ordinary painting, and, as in every other art, study and practice will bring knowledge and skill. A number of formulas for tinted paints may be found in the appendix; these are based on white lead, because for light colors that is practically the only material which the conditions allow; white zinc may be added if desired, but alone it is not recommended for a paint base. For dark colors, as browns and brownish reds, oxides of iron may be used exactly as white lead; also ochers may be so

used for dull yellows. But, in general, white lead is the practical and workable material for house painting, and always has been. The best "mixed paints," sold ready for use, are also good and very convenient for the amateur.

A. H. S.

July, 1918.

PREFACE TO THE SECOND THOUSAND

In Dr. Holley's recent book on "Lead and Zinc Pigments" it is said that in 1908 the editor of one of the paint magazines sent out an inquiry to the painters throughout the country regarding the reduction which they advised with paste white lead to make it into a paint of suitable body for use with the brush. The numerous replies received were chiefly remarkable for their lack of agreement; no general rule could be derived from them. The conclusion Dr. Holley arrived at, which was approved by numerous experiments by himself and other paint experts, was that a finishing coat should weigh about twenty-one and one-half pounds per gallon; and this

agrees with the previous experience of the writer. Mr. Lowe agrees that white lead paint should weigh over twenty pounds; but Mr. G. W. Thompson of the National Lead Company thinks nineteen pounds is enough; and a great deal of white lead weighing not over eighteen is undoubtedly used. These figures refer to Dutch process lead; some of the other makes are lighter.

This is an important question; it is the whole question of suitable paint body. If the paint is thin (which is what makes it light) a gallon will cover a much larger surface; it will have less hiding power, very much less than the weights show as expressed in numbers; and the film will be thinner. It is easier to apply; and those who use it say it is likely to be more thoroughly brushed out and make a more uniform and therefore more durable film. It costs less per gallon, and much less per square foot of surface painted

both in money and labor. The present writer stands by his original belief that a rather heavy-bodied paint will give the best service, but does not wish to obscure the fact that it is a matter in which there is a difference of expert opinion. It applies, of course, not to white lead alone, but to other paints.

It will be noted that on page 25 the cost of a gallon of white lead paint is given as $1.27; this is for a nineteen-pound paint; a twenty-one-pound paint, at the assumed prices, would cost $1.45 for materials; but the comparison here is with an average good ready-mixed paint, and the nineteen-pound white lead is more fairly comparable with that as regards opacity or hiding power, and probably also spreading capacity, for the working qualities of the best mixed paints are very high. Indeed, the values in every way of these paints are high; they are all based on lead and zinc, in the proportion of two to four parts by

weight of lead to one part of zinc; these together make seventy-five to eighty-five per cent by weight, or fifty to seventy-five by volume, the remainder being auxiliary pigments like barytes or silicates. But there are low-grade mixed-paints that are pretty poor stuff; and the user will be prudent if he pays for a ready-mixed paint a price at least equal to the cost of raw materials of a lead-and-zinc paint, except in the case of dull or dark colors, which are cheaper.

Perhaps not enough consideration has been given to the subject of ready-mixed paints. Among their advantages are definiteness and uniformity of color; intelligence, based on experience, in choice of materials for particular uses; the best makers make the varnish and driers which they use, and may select them better than the amateur; they also make special fillers, which are likely to be serviceable. It has been suggested that attention should be drawn to the difference in priming

and filling for outside and inside work; it will be observed that it is recommended that outside priming should be made from the standard or finishing paint by adding to it half its volume of oil; a large number of manufacturers say, add an equal volume of oil. It really depends on how absorbent the wood is; the soft places should be filled and the hard places not too thickly covered.

Good authorities say that wood which is to be varnished should never be oiled before filling; and it may be worthy of note that excellent paints for interior plastered walls, made with oil or varnish instead of size, giving "flat" or non-lustrous surfaces that will stand washing, are coming into use.

The first and last word in painting is, work the paint well with the brush into a smooth and continuous film in perfect contact with the underlying surface.

A. H. S.

PREFACE

FOR every man, woman, and child in this country more than a gallon of paint is used every year; and the relative amount is increasing. Paint is a necessity; it is an economy; it is a means of sanitation; it helps us to keep clean; it keeps us warm in winter and dry in summer; it brings light into dark corners; it beautifies our homes; it increases our credit; it raises our assessments; the most ignorant enjoy its benefits; and the most highly developed minds, whose culture is so profound that they have forgotten all they ever learned at college, retain its appreciation.

A subject so various in its uses, so universal in its appreciation, deserves attention, — indeed merits intelligent study. It is not pro-

posed in this little book to enter largely into the theory of paint manufacture, nor to describe its use for carriage-painting and the thousand and one purposes for which special paints and varnishes are made, but to tell simply and plainly the use of preservative coatings of one sort and another for the protection and ornament of common houses, as they are known, or should be, to every one of the author's fellow-countrymen. An experience of many years in the manufacture and use of paints and varnishes is the foundation of such knowledge as may be set forth, and while on many points even experts disagree, it will be the intention to set forth fairly sound and safe practice.

CONTENTS

HOUSE PAINTING

Materials.

PAINT is composed of two parts: a liquid, which is mainly oil in most house-paints, and a powdered solid, which gives color and body to the mixture. The liquid part is especially termed the vehicle; the solid, the pigment. The oil is linseed oil, made from flax-seed; raw oil is the natural oil, which will dry or become hard enough to handle, if exposed to the air in a thin film, in about a week; and boiled oil is the same, to which has been added a small proportion of "drier," and will dry in twelve to twenty-four hours. Paint drier, also known as japan, or paint japan, is a compound of lead, or manganese, or both, soluble

Oil Paints

in oil; it takes up oxygen from the air, and passes it over to the oil; for it must be known that oil dries, not at all by evaporation, but by absorbing oxygen from the air and uniting chemically with it, so as to make a new material, which is not a liquid, but is a tough, leathery solid, and weighs a fifth or a quarter more than the oil from which it was made. This is technically called linoxyn. The drier is, therefore, a chemical agent, and acts toward oil somewhat as kindling-wood does to coal, only it doesn't entirely burn up, but keeps on acting for a long time. If too much of it is used the oxidation, or combustion, goes on too strongly, and the oil gets over-oxidized, or burned, and its toughness and elasticity are impaired; therefore we must be sparing in its use, for we find the slow-drying paints are the most durable. Paint drier is usually sold as a liquid, and to a gallon of oil in paint not more than five

Drying of Linseed Oil

or ten per cent of drier should be added; less for outside than for inside paints. The best driers do not contain rosin, but most cheap driers do. It is not often necessary to use drier with boiled oil, as the manufacturer has already put in as much drier as is desirable. Drier should never be added to mixed paint, as the maker has exactly proportioned the ingredients to give the best results; there are cases where it is proper to add oil to a mixed paint, and sometimes turpentine, but not drier.

Turpentine is sometimes an ingredient of paint. In this connection it always means the essential oil of turpentine, a colorless liquid, lighter than water, highly inflammable, volatile. It mixes perfectly with oil, and increases the fluidity of paint. If we mix a considerable amount of it with paint, it makes a thinner film and one which is not glossy when dry, but dull, —

Spirits of Turpentine

what painters call "flat." Most paints stick better to a "flat" surface than to a glossy one, and so turpentine is often added to undercoats; also sometimes a "flat" surface is preferred, as a matter of taste, as a finish; but it is always less durable than a glossy one. Turpentine substitutes are usually benzine, a petroleum product between light naphtha and kerosene; often mixed with rosin spirits, or with wood distillates to conceal the odor. Genuine turpentine is usually preferred, but the substitutes are cheaper, and for some purposes quite as good.

Turpentine should not be put in with the pigment until after the oil; because with most pigments there is a sort of attraction between the oil and the pigment, and it is important not to prevent them from uniting as intimately as possible; and turpentine seems to do this. After the oil is all in and well mixed is the time to put in the turpentine. On the other

hand, if we are to add drier to paint, it is to act only on the oil, and it is well to mix it with the oil before the latter is put with the pigment. Moreover, the amount of drier is to be proportioned to the oil, not to the finished paint. To make paint thinner and more fluid, turpentine is much more efficient than an equal volume of oil; as it is volatile it does not act as a binder or cementing material, and therefore lessens the elasticity and durability of the paint.

Pigments.

The most important pigment is white lead. Every one has heard of Dutch process white lead; it was invented before the Dutch took Holland, but that is no matter. It is the standard white lead; it is made from metallic lead, corroding it by the aid of acetic acid, but it does not contain any acid; it is a basic carbonate of

White Lead

lead, a very white, impalpably fine powder; heavy, as all lead compounds are, and having a natural affinity for oil. It is sold as dry white lead, a powder, or as paste white lead, which usually contains ten per cent of linseed oil, and is a thick, heavy paste, to which oil may be added by stirring it in with a stick or paddle. A gallon of white lead paint weighs 20 to 22 pounds; if we add 3 gallons of oil to 100 pounds of paste lead we have $5\frac{3}{4}$ gallons of paint weighing 21 pounds per gallon; a gallon of oil weighs 7.7 pounds, a gallon of turpentine 7.2 pounds, and a gallon of benzine a little over 6 pounds. $17\frac{1}{2}$ pounds paste lead and 4 pounds oil make a gallon of paint; 16 pounds dry lead and $5\frac{1}{2}$ pounds oil make a gallon. A gallon of anything measures 231 cubic inches, and a gallon of water weighs $8\frac{1}{3}$ pounds. But linseed oil is sold by the barrel on the conventional or trade agreement that $7\frac{1}{2}$ pounds shall be sold as a gallon, or a

50-gallon cask will measure nearly 1½ gallons short; this is to cover the cost of the barrel. Similarly, turpentine when bought by the barrel is usually bought on Charleston or Savannah measure and is two or three per cent short, having evaporated through the staves of the barrel. White lead of similar composition is also made by a more rapid process than the Dutch process, and is probably not very different in its qualities. White lead of this composition turns black if exposed to sulphur, and white lead paint becomes yellowish after a time if not exposed to sunlight. In the sun it constantly bleaches out to a clear white.

Reducing paste paint to the consistency of paint by the addition of more oil is by painters called "breaking" it; this is done by putting the paste in a suitable vessel and stirring it with a paddle (or in a mechanical mixer) with enough oil to make a thick fluid; and

when it is uniformly mixed add more oil until the necessary amount has been put in. Paint composed largely of white lead improves by standing in a tightly covered package; it is appreciably better after a year than when it was first made. This is probably not true of other pigments, but there seems to be a slow action on the oil which is advantageous. White lead acts as a drier on oil, and it is possible to make a paint of white lead and raw oil without any drier which will dry fairly well in hot, dry weather out of doors.

Sublimed Lead

Sublimed white lead is a very different thing. It is made directly from ores containing lead and zinc by roasting them in a furnace; the lead is converted into a basic lead sulphate, and the zinc into oxide, and these are carried off in a current of air, and after cooling are collected as a white powder containing about five per cent of zinc oxide. This sublimed lead is a white powder,

very fine, and is not much discolored by sulphurous gases. It is claimed by the makers to be superior to the other kind; but according to Professor Ladd, who has investigated this matter, many troubles have been encountered in its use. It is less expensive than standard white lead, and is used by some manufacturers of mixed paints. Probably it is a valuable pigment, if not quite so good as the other. Zinc-lead is a similar compound containing a very much larger proportion of oxide of zinc.

Next to white lead in importance is white zinc, or zinc oxide, made by burning zinc ore in a current of hot air, though French zinc is made by burning the metallic zinc. It is the most nearly pure white pigment we know, and is a most valuable ingredient of paint. It is less heavy than white lead; 9 pounds white zinc and 6.2 pounds oil make a gallon of paint, which weighs 15.2 pounds, or 1 gallon oil and 12

White Zinc

pounds zinc make 1¼ gallons; or 100 pounds zinc and 8⅓ gallons oil make 10½ gallons of paint.

Lithopone is a white pigment made by adding a solution of zinc sulphate to a solution of barium sulphide; the result is a precipitate containing barium sulphate and zinc sulphide. Lithopone, however, is seldom of the exact composition thus indicated, and usually contains some zinc oxide. It is a pigment of considerable value, but cannot be used with lead; even a lead drier will turn it dark. It is said that it will mix with shellac, which neither white lead nor white zinc will do.

Lithopone

There are other white powders, which are often put into white paint, to cheapen it (extend it), or to produce certain desirable qualities. These are barytes, which is natural barium sulphate, ground to a fine powder; blanc fixè, which is precipitated barium sul-

phate; terra alba, which is hydrated calcium sulphate, or gypsum; whiting, which is powdered chalk, or calcium carbonate, marble dust, silica, silicate of magnesia, and China clay or kaolin. None of these are of any value by themselves; when wet with oil they become nearly transparent. It is not unlikely that some of these, in aggregate less than 15 per cent of the pigment, may be valuable; but their exact standing has not been settled.

Colored Pigments

There are two principal blue pigments, ultramarine and Prussian blue; the most important yellow is chromate of lead, or chrome yellow; ocher is a yellow clay, dried and powdered, containing iron; it is dull in color; green is a mixture of chrome yellow and Prussian blue, called chrome green; and for bright red we usually use a pigment made by precipitating a coal-tar color on barium or lead sulphate or some

other neutral base. English vermilion is too costly to be used much in house-painting; the dull reds are oxides of iron, such as Venetian red, Tuscan red, Indian red, and the like; the browns are likewise iron oxides. The blacks are either boneblack or lamp black, though graphite is used as a preservative paint on metal. There are, of course, many other more expensive pigments, which are used in carriage-painting and the like, which may sometimes be used in the house, but as a rule house-paints are made up of the foregoing. To mix these pigments properly with oil they should first be mixed in a mechanical stirrer and then ground through a burr-stone mill; but it is not unusual to mix them in a stirrer, or mixer as it is called, and use them directly.

Besides paint, the painter needs brushes. The best brushes for plain work are what are called pound brushes (most of them weigh less than half a pound, but that is the name

of them), which are round brushes nearly two inches in diameter and with bristles six inches long, when new. Next in value to these is an oval brush, two and a half inches wide. A great deal of house-painting is done with four- and five-inch flat brushes; the objection to these is that it is too hard work to use them properly; the paint should be well rubbed on, and you cannot do this with a very wide brush. When using a new pound brush (or any brush with very long bristles) it is necessary to put a bridle on the brush. This consists in tying the bristles with an encircling band, and some do it by winding the brush with cord; but the easiest way, and I think the best, is to wrap a piece of cloth around the brush, a piece say eight inches wide, and tie it firmly first to the binding. Then with another piece of cord tie it around the bristles, say four inches from the end of the bristles, and two

Paint Brushes

inches from the binding; then turn back the cloth, like a sleeve half turned inside out, and draw it tight, and tie it again around the binding. Trim it off, and the bridle is done. As the bristles wear short the bridle may be moved up, and finally removed. But don't buy a new brush with a bridle on it; take it off and see if the bristles are elastic and strong; soft, flabby bristles do not make a good brush. The best brush money can buy is a good investment.

For varnishing use an oval or flat varnish brush. These do not have so long bristles; for most work a brush two and one-half inches wide is large enough, though for flowing varnish on to a flat surface a four-inch flat brush is useful.

Of course, for painting sash a small brush is necessary; brushes made for this purpose are called "sash tools"; round brushes of various sizes, none very large. Some of these

have a convex end, others are chiseled; a chisel end is one that has been clipped off from each of two sides so as to give an edge along the middle of the end of the brush. Oval brushes are generally finished with a chisel end, especially oval varnish brushes; round and flat brushes not often, but flat varnish brushes have sometimes chisel ends. Some of these oval and flat bristle brushes are very useful in painting, especially about moldings and the like; from one to two and a half inches in width. In fact, a two-inch oval varnish brush is an exceedingly useful implement for a great variety of work. For flowing on varnish some use a soft, flat brush, made of camel's hair; it is convenient to have one narrow, say one inch, one medium, two inches, one wide, four inches. Paint is not easily handled with these soft brushes. Besides these, painters use dusting brushes, of stiff bristles, loosely built, spreading like a broom;

and for cleaning old paint they use ordinary scrubbing brushes, and sometimes steel wire brushes, which are scrubbing brushes with stiff steel wire instead of bristles; a good style is about three inches wide and six or eight inches long, with wires three inches long.

Care of Paint Brushes.

Brushes used in oil paints and in oleo-resinous varnishes may be kept fresh and clean over-night, or while carrying them from place to place, by wrapping them closely in several thicknesses of paper; but brushes used in spirit varnishes, like shellac, should be washed out at once in alcohol, as they dry very quickly, and are then difficult to soften.

The proper way to keep brushes, during short intervals when not in use, is in a brush-safe. A simple form, if several are to be kept, is a deep pail with a fairly tight cover; on the inside of the pail, at

Brush-Safe

convenient distances from the top, are nails, on which the brushes may be hung by corresponding holes bored in their handles, or by loops of twine at such a height that the bristles of the brushes are immersed, nearly up to the binding, in oil or turpentine which fills the pail several inches from the bottom. In this way the brush is prevented from drying, and yet it does not rest its weight on the bristles, which would cause it to get out of shape. If it is a shellac brush it must be hung in alcohol (or shellac varnish). It is always proper to hang a varnish brush in the kind of varnish in which it is used. A single small brush may be hung in a deep fruit jar, or a wide-mouthed bottle, by a string attached to the cover or cork. All large paint-stores sell brush-safes, made of tin, with hinged covers, and with convenient hangers for brushes; but the principle is the same in all, and any one can contrive one for his own needs.

When through with a job the brushes should be well washed out; this may be with turpentine, but a cheaper material is kerosene, which answers very well; if they can be rinsed out with benzine finally it is a good way.

It is also a good plan to wash out the paint with kerosene (or turpentine) and then wash the brush thoroughly with soap and warm water, finally rinsing out very thoroughly; then by jerking the brush rapidly through the air most of the water may be thrown out; then hang it up to dry where it will be safe from dust. Dust is the great enemy of varnish.

Renovating Brushes

Old brushes which have been allowed to dry with the paint in them are usually thrown away, or sold for a trifle to the junkman; in which latter case they come into the hands of a renovator, who softens them by soaking in hot kerosene, usually in a hot-water bath, the kerosene being

in the interior vessel and boiling water outside; after which they are cleaned by the use of a mixture of one part acetone and two parts benzole, or coal-tar naphtha. This mixture is a powerful solvent, and will dissolve the old dried paint out of almost any brush. Any of the modern varnish-removers, which contain these liquids, will do the same; and it is not necessary to throw away a costly brush because it has been neglected. But the best way is not to neglect it. The best brushes are the cheapest in the end, and a valuable brush deserves good care.

Mixing Paints

Paints are sold as dry colors, colors in oil, or ready-mixed paints. Only the professional painter, who has been trained in using them, should use dry colors, and he should avoid them as a rule; dry colors should be mixed with a little oil to the consistency of thick molasses, by rub-

Different Forms of Paint

bing the dry powder and the oil together with a spatula or large palette-knife; and if this color is to be mixed with another, or with white, the mixture should be made while each is a thin paste, if possible; then oil or turpentine is added to get the required consistency. Remember that a pint of turpentine thins a batch of paint as much as a quart of oil; the oil is not a great deal more fluid than the finished paint, and the turpentine is; turpentine or benzine is a more mobile liquid than even water, and oil is much thicker. So we always reckon these liquids to have double the thinning power of oil. They also penetrate wood more readily, and deeper. Colors in oil are dry colors ground through a mill with enough oil to make a paste, and are also called paste colors; they are thus intimately mixed with oil, and can easily be added to other paint mixtures, or thinned for use by themselves. Some dry colors, such as lampblack, do not easily wet with oil, do

not seem to absorb it, and are much better bought in paste form. To see what is the color of a mixture, a drop or two of the well-mixed paste is spread on a piece of clean glass; turn the glass over and look at the paint through the glass. This gives a smooth, perfect surface to look at. The color with which it may be compared or matched may be also spread on the same piece of glass by the side of it, touching it, and then when they are viewed through the glass the difference is perfectly seen. All painters practice this. If making up a tinted paint by a formula, never put in at once the entire quantity of color called for, as colors-in-oil vary in strength. Put it in gradually and test the color from time to time in the manner just described, until it is right. To make such paint, begin with the paste white lead, or whatever may be the principal pigment, and soften

Testing Color

How to Thin Paste Paints

it to a rather thin paste with a little oil; then add the tinting colors, and mix thoroughly. This is the stage when proper mixing can be effected. Then add the drier, and mix well; then the rest of the oil; then the turpentine. It is well to let it stand a day before using; then strain through cheesecloth, and it is ready.

It is very difficult, and sometimes impossible, to add a dry pigment to a thin paint so as to get a uniform mixture. It is also difficult to stir a thick paste, such as white lead, into a large volume of oil so as to get it uniform; like mixing flour paste with water, a little of the liquid must be mixed with the paste at first, then a little more, until it is all quite fluid; then it may be thinned.

Liquid Paints

Liquid paints are those prepared by the makers, ready for use; but all paints settle by standing and must be well stirred, and some mixed paints are pur-

posely made too thick to be used in order that they may be thinned more or less, with oil or turpentine, as circumstances require; but most are sold ready for use.

The fundamental principle of all painting and varnishing is that successive coats should be more elastic than those to which they are applied; otherwise we get "elastic undercoat cracks" which will be described under the subject of varnishing.

Theory of Painting

As a rule, a paint is made hard by increasing the proportion of pigment; but sometimes a full-bodied paint is used as a priming coat on absorbent wood, and the oil goes into the wood so much that what is left on the surface is porous and absorbent; theoretically it is hard enough, but practically it is spongy; and when another coat of paint is applied, the oil in the latter dries on the outer surface, or "skins over," before that in the under part

of this second coat is set, and so this oil may be absorbed by the dry priming coat and leave the under surface of the second coat too dry, and then the latter is liable to peel off. Even white lead, as a priming coat, will sometimes act this way; but it is common with ocher, which is often used because it is cheaper than white lead; and the best French ocher is very good, but many of the substitutes do not seem to hold the oil properly, and ocher primers have come into a disrepute which is not wholly deserved.

Ocher Priming

The finest French and English ochers are quite different from the cheap and coarse ones often sold; and as ocher takes a great deal more oil than white lead, persons accustomed to the latter do not find it a safe material. The priming coat is the most important, and the most common cause of peeling is moisture or pitch in the wood; on old buildings

leaky gutters often let water inside the walls.

The cost of the paint is not so much as that of the labor in using it; and cheap paints usually have less value as compared to their cost than the better ones. There is as yet no oil which is an acceptable substitute for linseed oil; and cheap driers are always dangerous.

Approximately, when oil is very low a good drier should cost not less than twice as much per gallon as oil, and when the oil is very high it should not be lower in price than oil. Drier is used in small proportion, and it is necessary that it be good. The buyer should see that it comes from a reputable maker.

Driers

The composition of a priming coat should depend somewhat on the wood. Soft woods, as white pine and whitewood, absorb oil and more oil and less turpentine are used than with

hard and pitchy woods, which are penetrated less, with which more turpentine is desirable.

The second coat is not expected to penetrate, and is a full, heavy coat, usually called the body coat. The third coat contains more oil, which increases the elasticity and on drying affords a gloss; a smooth, glossy surface wears well. If a high gloss is desired, a quarter or a third of the oil may be replaced by a highly elastic "spar" or marine varnish; but a cheap or quick-drying varnish will have ruinous effect. Boiled linseed oil dries with a gloss, and half the raw oil may be replaced by it, in which case the drier should be left out.

Effect of Sunlight

The effect of direct sunlight is to make paint hard and eventually brittle; hence on the south side of a house more oil may be used than is desirable on the shaded side, and roof paints should be the most elastic of all.

In fact, some of the best paint-makers put a fifth fish oil (refined menhaden oil) into roof paint, and it is probably good practice.

As a rule, tinted paints last longer than pure white, because the color keeps out the chemical rays of sunlight, which are harmful to paint. For example, "Colonial Yellow," which is white lead tinted with chrome yellow, used as a body color, is more durable than the same white lead without tint used to paint the trim white, though all the exposure conditions are the same.

Exterior Painting.

If we are to paint the outside of a new house, the first thing is to go over it and "stop" the knots and pitchy places. This is done by covering them with a coat of heavy shellac varnish. The tendency is for the pitch in the knot to ooze

Stopping Knots

out and soften the paint and discolor it. The shellac is supposed to stop this, but it does so only very imperfectly; however, there is nothing else to do. This is so serious a difficulty that the late Mr. Masury, a celebrated manufacturer and paint expert, advised leaving the house unpainted, to the weather, for a year; by which time the pitch will be either washed out or hardened. In fact, it is not unusual for the paint applied to houses of southern pine to come off in the course of two or three years (or one year), and then the next paint adheres all right. However, most people insist on having a new house painted immediately, and the best that can be done is to stop the knots and the worst places with shellac. This works better inside than out.

Then the priming coat is to be applied. Consider now what will happen if a coat of good thick paint is put on a clean board.

The oil is rapidly absorbed; but the pigment stays on the surface, and having no oil, or little, to bind it, it shortly becomes a dry powder and falls off. To prevent this, the obvious thing is to use less pigment and more oil. Therefore, to make a priming coat, add a half gallon of oil to a gallon of ordinary paint; a spongy wood, like redwood, may take more oil.

Priming Coat

Redwood is a peculiar wood; it is very open and spongy, so much so that it is reputed a comparatively safe building material, because if it takes fire a little water puts the fire out, as it is so readily absorbed by the wood that it ceases to burn. This explains the trouble often encountered in making paint stay on it; it requires more oil in the priming coat than other woods, so that the pores may be filled with oil, and thus a surface be formed for the adhesion of the subsequent coats of paint.

Another very difficult wood to paint is cypress. This is not bad where the grain is straight and uniform, but around knots and burls the grain is filled with pitchy matter which effectually prevents the entrance of the oil of the priming coat. This resistance is not overcome by the addition of turpentine; and such places must be treated as pitchy places in hard pine, by a coat of shellac, which nevertheless is not satisfactory. Probably the only way to get really good results is to leave it exposed to the weather for a year before painting. On inside work the use of shellac is less objectionable, as it is permanent indoors. A priming coat should be used freely; put on all you can; not enough to run, but up to that limit. This coat is to fill the pores of the wood, and it is the most important of all. A gallon of this thin paint will cover about three hundred square feet. When this is dry, go over the surface and faith-

fully putty up all the nail-holes and other holes. If you put on the putty before the priming coat, it will not stick. Putty will be described elsewhere; it is crowded down hard into the holes with a stiff steel putty-knife. Then begins the real painting. Most houses are primed with some light color, the basis of which must be either lead or zinc. A not uncommon belief, much disputed among the advocates of either lead or zinc paints, is that a mixture of the two is better than either alone. White lead tends to lose part of its oil by weathering, and then the loose pigment — not the whole of the paint, but the superficial part — comes off as a powder; chalks, as the painters say. Zinc does not do this, but makes a hard coating which tends to crack and peel off; and a mixture of, say, two parts white lead to one part white zinc is more durable than either. This will in many cases be colored by some of the pigments already

Puttying

mentioned. A little black mixed with white makes a pure gray; but a more agreeable gray results from a mixture with this of red, which makes a warmer tone, or blue, which is colder. Black and red make brown; drab and fawn color contain gray with red and yellow. Green is a mixture of blue and yellow, and the pale greens are derived from this by adding it to white; but olive-green contains also an appreciable amount of yellow, more than enough to make a neutral green, and may be darkened with a little black. Orange is yellow with red, and with white this makes buff. Blue with red makes purple, and this with black gives maroon; a bright red with a little blue is crimson, and red with a little yellow is scarlet. White with a little red is pink. Besides the pure colors for tinting, already described, it is desirable to have a few others; thus, a good yellow ocher is a clear but not bright brownish yellow, and with

Color Mixtures

white gives straw or corn color; burnt umber is deep brown, and with white gives warm or reddish drab tints; raw umber gives yellowish drab.

We may well consider the price we will have to pay for paint. Dry white lead is seldom sold as low as seven cents a pound; white zinc at six cents is a moderate price; oil has within a few years varied from ten and a half to four and a half cents a pound; let us say six cents for oil, and if we put in the necessary drier at the same price as the oil we shall underestimate it, for turpentine costs more than oil, and good drier is made from oil, turpentine, lead and manganese oxides, and with a large amount of highly skilled labor, while cheap rosin driers are an injury to any one who uses them. Calling the oil and drier six cents and lead seven, a gallon of white lead paint costs for materials $1.27, and a gallon of white zinc

Cost of Paint

ninety-six cents. A paint made of two-thirds of a gallon of lead and one-third of a gallon of zinc costs $1.17 for raw materials. If to this we add twelve cents for making a gallon, which is not far from the actual cost in large quantities, and eleven cents for packages and boxing, we have $1.40 as the factory cost. To this there should be added something for profit, and something for freight charges; and this gives an idea of what the buyer may expect to pay for a good article. If he buys a light-colored paint for less than the cost of good materials he must look out for himself. It is claimed by some undoubtedly expert paint manufacturers that by the addition of less expensive materials, such as silicates and the like, they are able to lessen the cost and at the same time increase the durability; this is certainly improbable; for if carried to extremes such paints are likely to be less opaque than pure lead and zinc paints, and hence may need an extra

coat to get the desired covering power, and this involves more labor. In plain work a man will put on from one to two gallons of paint a day (oftener one than more), so that the cost of labor is always more than that of the paint. If a dark-colored paint is used, this should not contain any lead or zinc, and will be at once more durable and cheaper; but, as a matter of fact, nearly all houses are painted with a light color.

Ready-mixed paints are sold in enormous quantities, and are convenient, uniform, and better made than those mixed by careless amateurs. If they are made of good materials and by intelligent men they are in every way desirable. Such paints should be used strictly according to directions.

Nothing is more objectionable than indiscriminate thinning of paint with turpentine or benzine, and nothing is more commonly done. Paint should, before using, be thoroughly

stirred up from the bottom, and it will be no harm to strain it through two thicknesses of cheesecloth. Most experts advise that to the first coat of paint which is applied over the priming coat, from half a pint in hot weather to a pint in cool weather of turpentine be added to each gallon of paint; this is to prevent gloss and enable the next coat to adhere well. For the last coat use no turpentine; the more gloss it has, the longer it will wear. A thin coat of paint will dry through more quickly than a thick one, and most paint manufacturers advise the application of thin coats. There is no doubt that a given amount of paint applied in thin coats is better than the same amount flowed on in thick coats. On the other hand, it is not usual to apply more than two coats over the priming coat, and if these are too thin — and they are often made so, not so much by excessive brushing as

Thick or Thin Coats

by thinning before use — they do not give proper protection. The late John W. Masury, the greatest paint-man of his time, advocated flowing on full, heavy coats. Mr. Houston Lowe, a manufacturer and undoubtedly a high authority, classifies pigments as active and inactive to linseed oil, and believes that active paints, like lead and zinc, are best in thin coats, and inactive, like iron oxides, etc., are better in thick, heavy coats. More time must be allowed between coats if they are thick; never less than a week; two weeks is better, a month still better. Painting is best done in moderately warm weather, not below 50 degrees F., better at 70 degrees F.; in cold weather more time must be allowed for it to dry, and less uniform results are obtainable. It must be done in dry weather. Heavy coats in cold weather wrinkle and do all sorts of bad things. A gallon of paint ordinarily covers about 500 to 600

square feet one coat; it may be brushed out to cover nearly twice that surface, but I do not approve of such thin coats. Some do.

The door- and window-casings, corner boards, and the like, are collectively called the "trim"; the majority of painters do not paint these until they have laid on the body color, but some good painters advise painting the trim first. Of course the cornice is always painted first of all, as paint may drip from the brush on the wall below. The trim, which is usually painted a different color or shade, amounts, on an ordinary house, to one-fourth or one-third the whole; it should be carefully estimated beforehand. A good man will cover 800 square feet in ten hours, if painting from a ladder; 1100 to 1500 square feet if painting from a platform; but on intricate surfaces, like piazzas, very much less. Some painters

Amount Painted per Day

regard these figures as rather high; there are great differences in houses.

Wall-shingles are sometimes, but not usually, painted; they are often colored with a shingle-stain, which is a coloring matter dissolved or suspended in a volatile liquid called creosote, in which the shingles are dipped. Roof-shingles are sometimes dipped in linseed oil and allowed to dry before using. Tin or other metal roofs are difficult to paint, because the tin has an imperceptible coating of grease, or of some chemical substance used in its manufacture, which prevents the adhesion of paint; if this is removed by thoroughly scrubbing the surface with soap and water, or with coarse cloths wet with benzine, the paint will then adhere. Galvanized iron rain-spouts and gutters are to be treated the same way, otherwise paint will not stick to galvanized iron until it has been some time in use. Roof-

Roof Painting

paint should contain no turpentine and little or no drier, and should be rich in oil. "Fire-proof paint," sometimes used on shingle roofs, is made by adding to a gallon of any good paint about a pound of powdered boracic acid. This is not really fire-proof, but retards the spread of fire; the heat fuses the boracic acid to a sort of glass, which keeps out the air. It is of no value until it gets thoroughly dry, and in the course of a year or two the acid is washed out by the rain; for a time it has considerable effect.

Canvas Roofs

Canvas roofs and floors are made thus: the canvas is nailed down, avoiding any large wrinkles, but paying no attention to small ones. Then wet it thoroughly with water; the cloth will shrink and be perfectly smooth. It is customary to apply white lead paint while still wet; but it may be allowed to dry before painting, as the wrinkles do not come back.

As to paints not based on lead or zinc, they are dark in color, made with inert pigments, and are usually very durable, more so than the lead and zinc paints. The following suggestion may be considered properly in connection with exterior painting: in building a house, the door and window frames should receive a coat of paint, which may be a cheap iron oxide paint, on their inner surfaces, that is, on the surfaces which will be concealed in the subsequent construction. This will have great effect in preventing decay, and should always be done. The under side of piazza floors and door-steps should be similarly protected. Exterior varnishing, as of railings, will be considered with the general subject of varnishing.

Painting Structural Metal.

By structural metal we commonly mean steel and cast iron; wrought iron is rarely used, and is more durable than steel. Cast iron is much less liable to rust than steel; and as it is thicker, there is less danger of its total destruction. Steel, if not properly cared for, perishes more rapidly than wood; and it is therefore imperative that it should receive adequate protection.

Cleaning Metal

In the first place, the surface must be clean. If it is already rusty, do not paint over the existing rust; clean it off with steel scrapers, wire brushes, and finally with dry scrubbing brushes. It would be better if it could be made absolutely clean by the use of acid or the sand blast, but the steel used in houses is not likely to be treated in this way. But do not spare labor to get it as clean as possible; then the paint will

stick to the metal. As the oil does not soak into the surface, it is not necessary to have a thin paint, but it may receive three coats of some good paint. Graphite is largely used as a pigment for these paints; there are some varnish paints and varnish-like preparations which are good; red lead mixed with linseed oil, in the proportion of twenty-five to thirty pounds of pigment to a gallon of oil, mixed on the spot and immediately before using, is very much liked. It makes a good under-coat; its color may be changed in following coats by adding lamp-black, or it may be covered by a coat of some other paint. Whatever paint is used should be well brushed on to the surface of the metal, in order to remove, as much as possible, the film of air which tends to prevent perfect adhesion, and any crevices where the steel is riveted should receive special attention. The rust usually appears first on edges,

angles, and rivet- and bolt-heads; care should be taken that these receive full coats of paint. Slow-drying paints should be used on structural metal, and plenty of time to dry should elapse between coats.

Interior Painting.

Sometimes all the interior woodwork is painted; often, in houses where varnish is the principal finish, certain rooms are painted. For this a somewhat quicker-drying paint is used than for exteriors; paint is much more durable when not exposed to the weather, and a quick-drying paint is allowable. This may be an ordinary oil-paint, such as has already been described; more often it contains a portion of varnish in place of part of the oil, and is called a gloss paint, as it has considerable luster; these, if well made, are the most generally serviceable; for fine finishes enamel

Priming and Puttying

paints are used. In these the vehicle is a varnish. Before beginning to paint, all knots and pitchy places, and all sap-wood, are given a heavy coat of shellac varnish. In all cases the foundation is a priming coat of white lead and oil, to which ten per cent of pale japan drier has been added; it should be almost all oil, very little lead. When this is dry, all nail-holes and crevices should be puttied up; the putty for this purpose is made by working dry white lead into paste white lead until it is of the right consistency; this dries quickly and very hard. It is not applied with a steel putty-knife, as this is liable to scratch the wood, and scratches will show on interior work; use a wooden spatula, or a conveniently shaped stick of hard wood. The white lead putty is made immediately before using. The first full coat is lead, oil, and turpentine; this may be made by thinning paste lead with a mixture of equal parts oil and turpentine;

this will dry quickly to a hard, "flat" surface to which the next coat will adhere. The next coat should have two-thirds as much turpentine in it as the preceding, and the final coat none at all. If there is any gloss when the next to the last coat is fully dry, it must be removed by lightly rubbing with sandpaper, or with curled hair, or with a handful of excelsior. If an enamel paint is to be used for the finish, the second full coat is sandpapered to produce a smooth surface, over which the enamel is flowed on in a full coat. For extra good work this coat of enamel, when quite hard, is sandpapered, and another coat of enamel is applied. This may be left with its full gloss, or it may be rubbed with pumice and water to a flat (dull) surface.

Finishing Coat

When paint or varnish is spread out in a thin film it remains a liquid for a considerable time, then becomes a sticky, jelly-like sub-

stance, which will not run; then it becomes firmer, but still sticky; in this condition it is said to be "tacky"; then it becomes hard enough to handle. From the time it is applied until it first reaches this stage, the time should be noted; suppose it to be twelve hours; then at least four times as much longer, or forty-eight hours, or sixty hours altogether, should pass before another coat may be applied. A longer time than this is better, but this is the shortest; and this rule applies to outside and inside work, and to varnish as well as paint. For very quick-drying varnishes, such as shellac, this rule does not allow nearly enough time.

Time Necessary for Paint to Dry

Old plastered walls may be given a coat of priming and then painted as though they were any other kind of a prepared surface. Many painters give a plastered interior wall a coat of size, or thin solution of glue, for a priming coat. New

Painting on Plaster

plaster is alkaline and is liable to attack paint; it is better to let it stand a year; but if necessary to do it at once, give it a coat of strong alum and soap size, as described under the subject of Kalsomine; when dry, sponge off and paint. Size is not used on exterior work.

Varnishing.

There are two principal kinds of varnish, spirit and oleo-resinous. The most important spirit varnish is a solution of shellac in alcohol; the American standard is made by dissolving five pounds of shellac in a gallon of alcohol; but this is too heavy for common use, and three and a half pounds is more generally suitable. Shellac is naturally dull orange-yellow in color, and is called orange shellac in distinction from white shellac, which is the same bleached with chlorine. It is of better quality before bleaching, but, of course, darker in color. Orange

Shellac Varnish

shellac varnish may be made in an earthen jar, half full of alcohol; to each gallon of alcohol weigh out three and a half pounds of dry shellac (gum-shellac), in flakes, and at night gently drop this into the alcohol. Do not on any account stir it, not even once. Cover it, and next morning stir it with a stick; avoid anything with iron, as iron quickly discolors it. Once an hour stir it for a minute or two, and by night it will be dissolved. White shellac is dissolved in a churn, or in a vessel where it is agitated with a mechanical stirrer. Orange shellac will dissolve in 85 per cent alcohol, though stronger alcohol is better; but white requires 95 per cent. White shellac resin does not keep well; it is liable to become insoluble, and should be dissolved as soon as purchased. In spirit varnishes the liquid, or vehicle, is volatile and serves as a means of spreading the resin in a thin, uniform film. Damar is another spirit var-

nish, and is a solution of damar resin in turpentine.

Oleo-resinous Varnish

Oleo-resinous varnishes are made by dissolving certain resins in linseed oil, with the aid of heat; and as one effect of the resin is to thicken the oil, they are thinned with turpentine (or a substitute). The larger the proportion of resin, the quicker they are to dry, also the harder and more lustrous, but also the less elastic and durable. The best of these are more durable than the spirit varnishes. The dark-colored varnishes are less costly than the paler ones, because the clear, transparent resins are more rare and expensive; but they are just as good in everything but color, and for many purposes this is no objection, as where they are used over dark wood, or as an ingredient of paint (except pure white paint).

The resins used in varnish-making are of vegetable origin, and come from the warmer

parts of the earth, mostly from Africa, the Philippine Islands, and from Brazil; though one important and valuable resin comes from New Zealand, which is outside the tropics. They have formed lumps on the trees, as spruce-gum is found on spruce trees in this country, but in larger pieces; but for the most part they are dug up from the earth, the trees which produce them having long ago fallen and decayed, and by being long buried in the earth the resin has become harder and more valuable. Fresh resins are, as a rule, too soft to make good varnish. They are of many different kinds, and are believed to have been produced by various hardwood trees. The varnish-maker puts a hundred pounds of resin in a kettle over a hot fire, and when it is melted it is at about the temperature of melted lead; then he puts in hot linseed oil. If he puts in oil equal in weight to the melted resin

Source of Varnish Resins

Making Oil Varnish

(which has lost between a fifth and a fourth of its weight in melting), he will make a hard, lustrous varnish, suitable for tables and other furniture; if he puts in twice this amount, he will have a varnish suitable for general interior house-varnishing, elastic and durable, but not quite hard enough for furniture; if he puts in three times as much oil as resin, he will make a very elastic, durable varnish which will get hard out of doors, but indoors will harden too slowly to be agreeable to use. After the oil is put with the resin the compound is cooked several hours until it has thoroughly united; then turpentine is added in sufficient amount to make it thin enough to use, for it is evident that the resin will have thickened the oil so that it would not brush out.

Use of Turpentine

It will be seen that the first and most important cause of differences in varnishes is the relative proportion of resin and oil. It is also

true that if the varnish is not cooked enough to thoroughly combine the ingredients, it will lack durability; and also that it may be partly decomposed by overheating. If it is just right, it will repel water, and not be affected by it; but if not well made, or if made of poor materials, it may absorb water and be injured if subjected to its action, which is certain to take place. One of the most important and easily made tests for varnish is to varnish a board well with it and let it dry well; then put a wet sponge on it over-night. If it is bright and clear next morning, it is a good varnish of its kind, so far as durability is concerned; but if it turns white, it shows that it has absorbed water; and if it remains white after it has dried out, it shows that the water has dissolved out part of it. Such a varnish should not be used on wood-work about a house.

Sponge Test

It is not a good sign to have a varnish dry

very quickly, as it may indicate that it is overloaded with drier, and that will injure its durability. A good house-varnish should be dry to the touch over-night, at summer temperature in dry weather, but it should stand a week before receiving another coat.

How to Apply Varnish

Varnish should be put on in a thin coat, rapidly brushed out; if it is of good flowing quality and does not "set" rapidly, it is usual to brush it on with the grain of the wood, then cross-brush it, and again brush it with the grain; in this way inequalities in the coat are obliterated, and a fine uniform film is the result.

Fillers

The varnish-user classifies woods as open- or close-grained; the most common open-grained woods are oak, chestnut, and ash; close-grained, the various sorts of pine, cedar, cypress, maple, birch, whitewood, cherry, etc. Open-grained woods must have the grain filled with what is called a

wood filler; this is a sort of paint, made of silex, or ground quartz rock, mixed with a quick-drying varnish to the consistency of paste, hence called a paste filler; it is thinned with turpentine before using. It is nearly colorless; but if desired to stain the wood, before using, the filler may be colored as desired with an oil stain, which is a pigment ground in enough oil to make a paste; a little of this is added to the filler when thinning it. The filler is rubbed into the surface of the wood with a short, stiff brush. It will be fairly dry to the touch in a quarter to half an hour, and the surplus is then rubbed off with a handful of excelsior, rubbing hard across the grain of the wood, to force the filler into the pores as much as possible. Use sticks, not steel tools, to clean the filler out of corners and quirks of the woodwork. Interior trim is usually finished in its natural color; but sometimes the window-sash is stained, to

resemble cherry or mahogany (with raw sienna); and sometimes the woodwork is colored with a dye dissolved in alcohol or turpentine; water stains are not used, except as to be described later. The filler should be allowed a day or two to dry, but close-grained woods do not require filling; then the first coat of varnish is applied. Greater economy will result if a coat of oil is first used, but it darkens the wood somewhat. When the varnish is dry, in five to ten days, rub it with curled hair or excelsior to remove the gloss, and apply the second coat; treat this in the same way. This may, however, be rubbed lightly with fine sandpaper or glass-paper.

Rubbing Varnish

If the third is to be the finishing coat (four coats are better), it may be left with the natural gloss, or it may be rubbed with pumice and water to a dull (flat) finish. The natural gloss is the most durable. For rubbing with pumice, a piece of felt is used; it may be had

from half an inch to an inch in thickness; this is thoroughly wet with water, then a little powdered pumice is put on it, and the surface is rubbed with long, even strokes. From time to time the surface is washed off with clean water, wiped off with a piece of clean chamois-leather, dried with another chamois-leather, and examined.

Exterior Varnishing

All surfaces exposed to the sun, as window-sash, sills, jambs, inside blinds, outer doors, railings, and the like, are treated as exterior work, and do not receive the varnish used on interior trim, but are varnished with what is called spar-varnish, which is made for the spars and exterior woodwork of yachts. No filler is used on this work, as under the influence of the direct rays of the sun it would be decomposed and come out. The whole surface is built up of successive coats of spar, lightly sandpapered between coats; but the last is a full coat flowed

on, and left always with the natural gloss. Outside doors need varnishing every year; but inside work, though done with a less elastic varnish, if these directions have been followed, and if good materials have been used, will last fifteen or twenty years; so great is the effect of the direct sunshine.

Shellac as an Interior Varnish

On interior work shellac is a good first coat material, but it should never be used on exterior work, nor where it will be very hot, as about a fireplace, as it will melt and blister. For most interior work, shellac is a good varnish, and white shellac discolors wood less than anything else. It is applied in thin coats and given plenty of time to dry. Two coats may be applied the first day, six hours apart; after that allow two days between coats. It will appear to dry very rapidly; but if plenty of time is not taken we shall reach a point where it will not dry at all, or at least will

seem so. It requires many coats; does not require rubbing between coats, as it will stick anyway, but every four coats ought to be well rubbed, to get a smooth surface. Eight to twelve coats are required for a first-class job. On account of the labor required, it is an expensive finish, but it is very handsome and lasts well. It makes a good floor-varnish; when the floor is well filled with it, a very thin coat once a month, which will dry in a few minutes, will keep the floor in good condition. One more word about fillers. Never use a so-called liquid filler on any account. Nothing but trouble will come of it. A coat of shellac varnish may be used, if desired, as a filler; it is not much of a filler but it is a good surfacer; but what are sold as liquid fillers are cheap and villainous rosin mixtures and are no good.

Let us consider what will happen to a coat of paint or varnish if we apply a hard-drying

layer over an elastic one. If we were to paint with something — say white zinc — which would make a hard, somewhat inelastic coating, on a rubber balloon, such as children have for toys, and the paint were to dry while the balloon remained the same size; and then if we blow up the balloon so that it will be larger, and consequently the rubber film, which is the foundation, is stretched, it is obvious that the dry paint will crack in every direction, and the rubber will show through the cracks. That makes what the varnish-man calls an elastic undercoat crack, and it is more common than it ought to be. The natural effect of exposure is to harden the outside of a film, so that in many cases if the film were originally of one nature throughout it would become less elastic on the outside; so the general rule is to have the hardest material first applied, then that which is a little more elastic, and so on, with

Elastic Undercoat Crack

the finishing coat most elastic of all. We do this in the ordinary method of painting, as already described, having less oil in the undercoats; the fact that we have a great deal of oil in the priming coat on wood does not count, because that is absorbed by the wood and becomes a part of the material which we begin to paint. In carriage painting, which if properly done is the highest class of technical painting, the workman begins by filling the minute pores of the wood with oil; then he stops the larger pores with a siliceous filler; then he builds up an extremely hard and perfectly smooth surface with a sort of varnish paint having a gritty mineral base, and having thus established what he considers an unchanging foundation he is ready to begin to paint. We cannot afford to do all that in house painting, but it must be remembered that our priming coats and putty and fillers are not properly part of the painting or varnishing; they are

treatment of the wood to make it ready and fit to paint and varnish. And if you cannot have a good foundation, you might as well not do anything. It may be asked how we get cracks over an elastic under-coat; it is because the wood or other solid substratum does not expand and contract, under the influence of the weather, at the same rate that the paint does. Now if the paint is in every place firmly cemented to the wood, it will be stretched or compressed, only a very little in a place to be sure, but with great force, and the result will be that it will remain a continuous film; but if there is an elastic film between, patches of the paint or varnish will remain compact, and there will be cracks between these patches. Paint or varnish which does this is said to "alligator," from the resemblance to alligator leather.

Proper Foundation for Varnish

It will be obvious from this that it is necessary to give the priming coat, which is mainly

oil, time to dry; and also that this priming coat should be made with raw oil rather than boiled oil, for raw oil will soak deeply into the wood, and that is where it belongs; while boiled oil tends to form a skin on the surface, and so remains outside; and under this skin a soft body of oily paint is formed. This is really the reason why so many object to the use of boiled oil; it has a tendency to form a glossy skin outside before it begins to dry from the bottom. Of course all oil does this to some extent, but it is generally believed that raw oil with enough liquid drier in it to make it dry in the same time as a kettle-boiled oil will dry more uniformly. Boiled oil makes a more glossy, varnish-like film; in fact, oil may be boiled so much and in such a way as to make a sort of varnish of it, and a great deal of such varnish is used in the useful arts. Boiled oil has its use in making paint, but it is not in the priming coat; except for plaster walls.

Not infrequently there are porous places in the wood which absorb the priming coat so completely that some of the oil of the next coat will soak in, and this leaves the paint on those spots dull or "flat." Also there are hard or pitchy places where the primer does not penetrate, and dries on the surface, and there will be glossy spots. Spotting from either of these causes is not the fault of the paint.

Spotting

Blistering is generally caused by moisture in the wood, especially in soft or sappy places. It is a good plan to postpone painting a new house until after the plastering is done, for this introduces a great amount of water which evaporates directly against or close to the outer wall, and the moisture is liable to penetrate the siding and make blisters in the new, soft paint. It must be remembered that paint continues to get hard for probably a year, and paint which is

Blistering

only two or three weeks old is not yet in its permanent condition.

It is of great importance to have the oil in the priming coat sink deeply into the wood; and if the latter be of such nature (like southern pine) that it will not do so, then there is danger that it will peel off. Paint contracts on drying; and the second and third coats exert a strong pull on the priming coat, tending to pull it off unless it is securely attached to the wood. This is more likely to occur on the south than on the north side of a house, as the action of the sun has much to do with it.

Peeling

In repainting an old house this must have close attention. If the original priming coat is not in good condition it must be removed; to examine this, we must scrape or wire-brush all loose and decomposed paint; and if the original primer does not hold firmly to the wood, it may be necessary to burn

Burning Off

off the whole of the old paint. Burning off is done with an instrument called a painter's torch, which burns alcohol, naphtha, or kerosene, and with which a strong blast of flame can be directed against a surface. The paint is not really burned; but it softens and seems to melt, and is then immediately scraped off with a steel scraper. It is, of course, a slow and consequently somewhat expensive operation; but there are cases where it is the cheapest thing to do, in the end.

Varnish Removers

Besides the painter's torch, varnish removers are used to take off paint and varnish; but, being more expensive, these are used only on indoor work, and especially on moldings and the like, where the torch may do damage. A varnish remover is a liquid which will dissolve dried varnish and paint; it softens the film so that it may be scraped off, or cleaned off with a very stiff scrubbing brush. It is usually made of ace-

tone, benzole, and similar liquids, and the best contain some waxy substance which prevents the film from drying up again rapidly. They are inflammable and must be used with care. The best are patented. After removing the old paint or varnish, the paint remover is washed off with benzine, but the surface should stand exposed to the air at least a week to let the last of it evaporate, before repainting.

A Colored Finish Without Paint.

A very handsome and comparatively new finish for open-grained woods consists in dyeing the wood with a water-stain; when it is dry the grain is filled with a colored filler; this filler may be an ordinary colorless silica paste-filler to which has been added a pigment of a suitable color, or it may be paste white lead if a white color is desired. As the oil and turpentine

A Novel Style of Interior Finish

in the filler do not tend to dissolve or mix with the color of the water-stain, we have a sharp contrast between the dyed wood, which forms a background, and the filler in the grain of the wood; for instance, the latter may be white on a blue ground, or dark blue on pale blue, or any other combination of colors which may strike the fancy of the designer. In this way very striking effects, harmonizing with the general color scheme of the room-furnishings, may be easily obtained. Of course, the wood will be subsequently finished with a transparent varnish, as any other wood-work would be. Some very costly and artistic buildings, both public and private, have been done in this way.

Floor-Finishing.

Probably the easiest thing to do with a floor is to paint it; a floor-paint should have a very elastic varnish for its vehicle. It is necessary that a floor-paint should dry hard and quickly, because floors must be painted frequently, and we cannot wait long for them to dry. By the use of varnish we can make a floor-paint that will dry in twelve to twenty-four hours, be water-proof, and glossy. If we make an ordinary oil-paint dry as quickly by adding driers, it is so much affected that it is not as durable as it should be; and if we do it partly by using turpentine, it diminishes the necessary amount of binder. The country painter adds to ordinary oil-paint a liquid which he buys under the seductive name of "floor paint hardener"; this is a cheap rosin varnish loaded to the last degree with driers, and is in about every rational way

Floor-Painting

the worst stuff known in the whole paint business. No rosin varnish should be used on any of the woodwork of a house, least of all on the floor. The varnish should be a good Kauri varnish, or its equivalent. It ought to contain about twenty gallons of oil to the hundred pounds of resin; it will need some drier, more than an ordinary interior varnish, but its quick drying is not to be obtained by diminishing the amount of oil, or the paint will chip and flake off. An ordinary paint will do for a floor if two or three months can be allowed for it to dry.

Kitchen floors are usually painted, but it is usual to varnish or wax the other floors in the better class of houses. In such cases, if the house is building, it is very desirable to leave the surfacing floor (for all floors should be double) unlaid until the last thing; after the plastering and painting are done, there will be little danger of its being injured, and then it

may be laid and immediately varnished. If the floor is of oak or other open-grained wood, it is customary to fill the pores with a siliceous paste-filler, as has been described for other work; if close-grained, no treatment is needed.

Now we have choice of three finishes. First, the use of an oleo-resinous floor-varnish; this should contain about eighteen gallons of oil to the hundred pounds of good hard varnish resin, as good in quality as No. 1 Kauri. This may be applied directly to the floor, and the first coat will sink in and be absorbed by the wood. We may, if we like, first fill the pores of the wood with linseed oil; there is but one objection to this, which is that it darkens the wood; it becomes somewhat darker immediately, but keeps darkening for some time. Anything containing linseed oil grows darker with age, — that is, any transparent wood-finish. And so it is true that an oleo-resinous varnish darkens

Floor-Varnishing

the wood somewhat. Not less than four coats of varnish should be applied; the trouble with all floor-finishes is that they are too thin, and wear off too quickly; for a floor has harder usage than anything else. And plenty of time must be allowed for each coat to dry.

Second, we may varnish the floor with shellac varnish. The same rules apply to shellacking floors that have been given in regard to its use on other woodwork; it is the least discoloring of anything that can be put on a floor, and is a very good finish. It is not as hard or durable as a good oleo-resinous varnish, but a thin coat of it, which dries in a few minutes, can be quickly and easily applied once in a month or two (or much less often in rooms little used), and will keep it always looking well. White shellac is usually employed for floor-varnish.

Shellac for Floors

Third, the floor may be waxed. It is common practice to first shellac the floor, one or two coats, and then apply the wax. The wax is not beeswax, but a harder wax; this is softened a little with oil, and then turpentine enough is added to make a paste, and this is put on the floor, and as soon as it is apparently dry it is polished by rubbing with a clean cloth or a brush. For this purpose a heavy-weighted brush, weighing ten to twenty pounds, is used, with a long handle like a mop-handle; with this the floor may be polished. After a week apply another coat of wax and polish again; keep this up for two months; after this it may be considered that the floor is properly waxed, and only a little need be applied. A waxed or varnished floor is always to be cleaned with a brush or with a broom wrapped in a soft cloth to avoid scratches. But the waxed floor, to be kept in fine condition, must be brush-polished every

Floor Wax

few days; and once in a couple of weeks should be sprinkled with a solution of wax in turpentine; or better, this may be put on with a brush or a cloth. Prepared floor-wax may now be bought everywhere, much better than the amateur can make.

A properly kept waxed floor is certainly the handsomest floor that is known; but if kept well polished it is excessively and, many people think, dangerously slippery.

It is not out of place here to tell of a very singular fact. A floor varnished every six months with a good Kauri varnish will keep buffalo moths out of rugs laid on it; similarly, a varnish of this kind thoroughly used about the woodwork, including the interiors of closets, has a very appreciable influence in keeping all sorts of insects out of a house. Shellac or wax will not do this.

Old floors are to be cleaned before varnishing or waxing. If nothing but shellac or wax

has been used on them, the wax may be cleaned off with a cloth wet with turpentine, and the shellac will wash off with a strong solution of washing-soda (carbonate); in fact, this will take off wax also. But if an oleo-resinous varnish, or a paint, has been used, it is removed with a liquid varnish-remover, which softens it so that it can be scraped off with a scraper; it may require more than one application. After the removal of the paint or varnish the floor is sponged off with benzine; care must be taken that there is no fire of any sort or description in the room or in any adjoining room. The varnish-remover consists chiefly of volatile and inflammable liquids, and too much care cannot be taken. Stains may then be taken out with a hot ten per cent solution of oxalic acid in water; after the stain is destroyed, wash with hot water and let it dry, then lightly sandpaper the spot.

Cleaning Old Floors

It is possible to clean a floor of paint or varnish with caustic soda; put the contents of a can of "concentrated lye" in a couple of gallons of warm water and wet the floor with it. After a time the old paint will be attacked and can be scraped off, and then the floor may be washed perfectly clean. Of course the caustic soda will sink into the wood, and it will be impossible to varnish it soon; but repeated washings, at intervals, for six months will take out the last of it, and then the floor will be in very good condition for varnishing.

Glazing.

Window glass is of two sorts: plate glass and sheet or cylinder glass; the latter is the more common. Sheet glass is made by blowing a cylinder of glass which for the larger sizes has to be about fifteen inches in diameter and seven or eight feet long; when cold the ends are cut off, the

Window Glass

cylinder is cut open lengthwise and put into an oven; when hot it can be opened and spread out into a sheet; such a sheet will afford a piece of glass 40 by 60 inches, which is the largest regular size. Smaller sizes are cut out of large sheets. "Single thick" glass is about one-sixteenth of an inch thick, and "double thick" is about twice this thickness. The products of different mills differ in thickness as in everything else, so there is no exact uniformity of thickness. All glass is imperfect, showing streaks of irregular thickness, bits of dirt, and bubbles; it is all inspected at the factory and graded. Foreign glassmakers have each his own marks for quality, so there are no grades corresponding to ours; but American makers classify sheet glass as AA, A, B, and "stock sheets." The sizes for single-thick glass run up to 28 by 34, and of double thick to 40 by 60 inches.

Plate glass is not blown, but is cast in plates

on iron tables fifteen by twenty-five feet; on these hot tables it is compacted and made of uniform thickness by a roller, which leaves it half or five-eighths of an inch thick; it is annealed first of all, and then ground with sand and emery to a thickness of five-sixteenths to a quarter of an inch thick, and then polished. There is, however, a thinner sort, about like double-thick sheet glass, called crystal plate, used for car windows and the like. Selected sheets of plate glass are reserved for silvering and are called mirror plate.

Plate Glass

New sash must receive a priming coat; if the sash is to be painted, this is a priming coat of white lead containing perhaps four or five pounds of white lead to the gallon; but if the sash are to be varnished, they are primed with oil alone. The oil usually has a little drier added to it, or boiled oil is used; but, as has been explained, boiled oil is not much

used for priming coats. The special object of priming is to prevent the wood absorbing oil from the putty. Ordinary putty is a mixture of whiting (pulverized chalk) and raw linseed oil; some makers add about five per cent cotton oil, to increase the keeping quality; it is mixed to a stiff mass, like dough, by machinery; but, like dough, it can be equally well made by hand. Machine-made putty of the best quality can be made and sold by the ton for three cents a pound; but it is almost impossible to buy good putty in the open market; marble dust is substituted for whiting, and rosin and mineral oil for the oil, and this putty is an injury to the consumer; it will not hold the glass in, it crumbles and falls out, and then the glass falls out and breaks, or if it is not allowed to go so far as that, it becomes necessary to take out the window, clean off the old putty and replace it. The conditions have become so bad that good

Putty

retail dealers have their putty made by hand by their own employees. At three cents a pound, a dollar will buy enough to putty all the glass in an ordinary dwelling-house. The man who is having a house built will do well to provide in his contract that he may retain from the contract price the sum of one dollar per window for two years, to be forfeited if the putty crumbles in that time. Then the builder will be interested in the matter; he can probably save only half a dollar on the whole house by buying inferior putty; and if this were generally practiced, this nuisance of adulterated putty would shortly disappear. Good putty lasts a lifetime.

White lead putty is too hard for setting window glass; the glass may be broken, and then the putty must be removed, and it is very difficult to do this with white lead putty; but one-tenth white lead may be put in ordinary putty with advantage, as it makes it quicker

to dry. Putty is applied with a putty-knife, which has a steel blade about $3\frac{1}{2}$ inches long and $1\frac{1}{4}$ inches wide at the end; some use a blade cut square across, others have the end beveled; it is purely a matter of habit; either will do the work.

Plate glass is always cut with a glass-cutter's diamond; sheet glass may be cut with a diamond or with a wheel, which is a hardened steel wheel about an eighth of an inch in diameter, with a sharp edge, set in a handle; the wheels are replaceable and may be bought separately, if the right kind of a holder is obtained. The operator has a little jar or wide-mouthed bottle of kerosene before him, in which he dips the wheel before each cut; this is essential to the proper use of the wheel. It cuts sheet glass perfectly well; but the diamond makes a deeper cut, and is necessary for plate glass.

Cutting Glass

The amateur will find it a help to lay a large

sheet of paper on the table, and with a rule make a pencil-mark where the edge of the pane of glass will come; then lay the piece of glass on it, put a straight-edge nearly over this pencil-mark, and with the straight-edge as a guide run the wheel over the glass; considerable pressure must be used; a little practice will soon show how to do it. The professional will lay the sheet of glass over the opening in the sash, and with the edge of the sash to guide his eye will with a free-hand movement run the glass-cutter swiftly across, and the glass falls apart on exactly the right line.

Bedding

Before putting the glass in place the workman spreads putty along the ledge on which it is to rest; this is called bedding the glass, which is then pressed firmly into place and fastened there with little triangular bits of sheet zinc, called glaziers' points; these are put in from nine to twelve inches apart, and are laid flat on the glass

and driven into the wood of the sash, the implement used for driving being a two-inch chisel which is held with its flat side on the glass and the edge away from the glass; that is, with the back of the chisel down, so as not to scratch the glass. If the pane is smaller than the opening, it is so set that when the sash is in its proper position the pane will rest on the sash-bar below it; then there will be a crack between the pane and the sash on one or two sides, and the chisel is held vertically over this crack, and with its edge a crimp is made in the triangular zinc point (which has already been driven), so as to prevent the glass from sliding about. Zinc will readily bend, while steel will not, and this is the reason zinc is used for the purpose. These points are of various sizes: No. 1 are used for double-thick glass, No. 2 for the lighter glass. Fire-proof wooden sash are covered with thin sheet metal, and for use with

Points

such sash steel slugs are made; these are triangular, $\frac{7}{8}$ inch long, $\frac{7}{16}$ wide at the wide end, and $\frac{1}{20}$ inch thick; these are also used for plate glass. It is of importance to use enough points.

When the glass is thus held in place, the rest of the putty is applied. This may be done while the sash is in a horizontal position; but the professional sets the sash upon a sort of easel, putties the right-hand side and across the bottom with one motion of the arm, then reverses the sash and putties the other side and end.

Sometimes, with soft-wood sash, bedding the glass is omitted, though wrongly so; but it is imperative for hard-wood and metal-lined sash, and for all plate and crystal-plate glass. But in case the glass has not been bedded in putty, we crowd some putty into the crack between the glass and the sash on the indoors side; this is called

Backing

backing the glass. Large panes of plate glass are not puttied, but are held in place with strips of molding nailed to the sash, and the crack between the glass and the molding is backed with putty.

Papering.

The first thing to be done is to clean the walls and ceiling. If there is old paper it must be removed; one layer of paper over another makes a thick coating; the paste of the outer layer does not come into contact with the lime of the wall, which would have a preservative effect, and so forms a breeding-place for germs of all sorts. To remove the old paper, first try stripping it off dry; often you may remove much of it this way. Then wet it with hot water, applying it with a wet cloth, a brush, or a sponge, as may be most convenient; but if it is a varnished or enameled paper it will be

Cleaning before Papering

well to put a handful of washing-soda (sal soda) in a quart of hot water and put it on with a brush or a swab, so as to keep the hands out of it; though it is not so very bad for the skin if not used too long. It may be necessary with a hard enameled paper to make scratches in the paper to let the water in; it is sometimes quite a hard task to get such paper off. But in general when the paper is wet you may peel it off in large strips, and scrape off the remainder with an ordinary steel scraper; some recommend scraping with a piece of sheet zinc, as less liable to scratch the wall. Persistent wetting and scraping will get the paper off. Notice whether the paper sticks well to the wall; if it does, it will not be necessary to size the wall; if it comes off easily the wall must be sized. New walls do not need it. If the walls have been kalsomined or whitewashed it is equally necessary to get the old material off, in the same general way as paper

is removed; a scrubbing-brush is useful. If the wall is cracked or broken, it is necessary to repair it; this is usually done with plaster of paris; always try it before using; wet up a little with cold water, and see if it sets and becomes hard; if not, get some that is fresh. It must be mixed a little at a time and applied within ten minutes after the water is added to it. It may be put on with a trowel or, more commonly, with a putty-knife. The common method of filling cracks is to cut the sides of the crack until it becomes V-shaped, then wet the sides of it with water so that it will not absorb water from the plaster of paris, and then press the latter firmly into it. But a more thorough method is to cut the crack out so that the channel thus made will be wider at its bottom than at the surface of the wall; thus it holds the plaster of paris more securely. Large holes are first filled to within an eighth of an inch of the surface and allowed

Repairing Walls

to harden, and then filled flush; this is to avoid shrinkage. Whiting is powdered chalk; many mix this in equal quantity with plaster of paris, and wet it with glue-size; this mixture does not set quite as quickly as plaster alone.

Size

Size is made by soaking a pound of glue over-night in cold water; in the morning pour off the water, and, having the glue in a tin or enameled pail or pan, pour on it enough boiling water to make a gallon. Then stir immediately, and the glue will commonly dissolve at once. To this may be added two to four ounces of alum, previously dissolved in a little hot water. A common practice is to also add a quarter of a pound of any good bar-soap, which should have been cut into shavings to make it dissolve easily. When the size is cold it is ready for use and is applied with a brush. It should be a thin jelly. If it appears to be too thick (glues differ in this) it may be thinned with

cold water to a consistency suitable for use with a brush. As has been said, if the wall has been repeatedly papered before, and if the paper comes off very easily, it should be sized before papering, and the size allowed to dry.

It may be well to say that one of the difficulties encountered by the amateur is the very quick drying of the paper on the wall. If it dries slowly, it may, if a mistake is made, be taken off and put on properly; that is, if in beginning to put on a piece it is found that a mistake is made, the end which has been put on may be moved to the right place; but if the work is going on in dry winter weather and the house is hot and dry, the paper must be put on exactly right the first thing, for it will dry enough so it will stick and tear. But if it is done in damp air in summer, when evaporation is slow, it is possible to be more deliberate, and this makes the work easier.

It has been said that size must be made and kept in metal vessels; this is because, if it is put in a wooden pail, that pail will probably never again be clean; and if the glue has begun to decompose in it, it will always be a source of trouble, and it may be of danger. The same is true of paste, and of kalsomine. Avoid wooden pails, and never let your brush stand over-night without thorough washing. Various unwise and ill-considered things at one time and another have been said about danger to health from wall-paper; also from paint. The only objections to wall-paper are that it may be put on one layer over another, but this should never be done, and probably is not now often done; and, second, that it is a somewhat rough and porous material which holds dust. This is much less true of varnished or enameled paper. No doubt there is nothing so entirely sanitary as paint or varnish, which are in their nature

Care of Size

non-absorbent and impervious, and which may be washed without injury. But the talk about people being poisoned by arsenic in wall-paper is nonsense. In the first place, hardly any wall-paper colors contain arsenic; and if present it is there as a precipitate which is insoluble and non-volatile, and couldn't possibly do any harm if there were a hundred times as much. Further, while a large dose of arsenic is poisonous, a very small dose is not so. There are cities in this country, such as Butte, Montana, where there is so much arsenic in the dust floating in the air, from the smelter-smoke, that cats, who lick the dust off, poison themselves, and cannot live there, while dogs and horses are perfectly healthy; and men, women, and children are just as healthy in these cities as they are anywhere else. Common salt is one of the necessities of life; yet a good-sized dose of it will cause vomiting, and no doubt an excessive

Wall-paper Poisoning

amount will cause death; but we do not call it a poison. If a room were painted with paris green, I do not believe enough arsenic could ever get into the air to be detected by the most exhaustive chemical analysis. The same may be said of the use of white lead; people using white lead, who are not of cleanly habits, are sometimes poisoned by it, — usually by eating their meals without washing their hands or beards; but that lead paint on the outside or inside of a house should be a source of danger, or should be other than entirely sanitary, is totally impossible; and, as Sancho Panza said, he that thinketh otherwise hath windmills in his head.

Needful Outfit

The outfit which the amateur paper-hanger requires consists, in the first place, of four boards about twelve inches wide and eight or ten feet long. Two of these boards should be planed smooth, as they are to serve as a table on which to spread the

paste on the paper; the others are to make a platform on which to work. There should be something provided to support these about thirty inches from the floor; they may be on boxes or tables, — the height is that of an ordinary table, — or trestles or "horses" may be had. A couple of stout kitchen tables make a good support for the boards which are to be used as a platform. A carpenter's square is useful, and so is a yardstick. It is necessary to have a pair of long shears, twelve to sixteen inches long; these cost about a dollar and a half. The professionals also have a rotary-wheel cutter for trimming, but it is not necessary. A good paste-brush, about seven or eight inches wide, costing from one to two dollars, is necessary; and a smoothing-brush, which is a long, thin brush, about ten or twelve inches long (wide), is very desirable; this is for smoothing the paper on the wall; the work may be done with a dry, soft towel,

but the brush is very much better; it costs seventy-five cents to a dollar. A clothes-brush may be used, in emergency. An eight-inch cloth-covered roller is also used for this; but a good brush is almost indispensable, and is all that is really necessary. To smooth down the seams a seam-roller is used; this is about an inch wide, with a rounded face; a smooth bed-caster will answer, but is not so convenient. This is to roll down the seams after they are partly dry. Flour paste is commonly used, and is the best; it is made by putting three pints of wheat flour in two quarts of cold water, and rubbing it until it is smooth and free from lumps. Then add to it eight quarts of boiling water (not merely hot, but actually boiling), and boil slowly with continual stirring for ten minutes. It is necessary to be particular about stirring it, or it will burn on the bottom. When it is cold, sprinkle in with thorough stirring two

Paste

tablespoonfuls of powdered alum. This will be about right, but if it should be too thick it may be thinned with a little cold water. Use cold. The best dish for making and using it is a large oval dishpan. Never put paste in a wooden pail, or in anything rusty. Wash out the paste-brush every night; do not leave it in the paste over-night. Only one edge of the paper is to be trimmed. Some of the professionals trim the paper first; the man sits in a chair with his legs stretched out before him, and lets the roll of paper lie on his upturned feet; as he draws it up into his lap he trims it with the shears, and with practice does this very rapidly. **Trimming**

But the more common way is to cut the paper into suitable lengths first, and then spread the paste on one of these pieces, applying it to one end of the paper first, and when about half the piece is pasted, fold the end over toward the center, being particular

to have the sides and edges exactly even. Then apply the paste to the other half, and in like manner fold that end toward the center. Then proceed to trim; the advantage of doing it this way is that the paste gets distributed to the edges perfectly even and clean, and you trim two thicknesses of paper at once.

Wall-paper comes in rolls, eighteen inches wide, and a conventional roll is eight yards long; but in fact it is always sold in double rolls of sixteen yards; but the price is usually made on the single-roll basis, so if you buy twenty rolls you get ten pieces of paper each sixteen yards long, each piece rolled up in one (double) roll. To estimate how much you need, you are to measure the area to be covered; measure the total length of the wall, adding up the four or more sides, and multiply this by the height; then figure up the area of the doors and windows and take that out; this gives the total number of square

Size of Rolls

feet of wall to be covered. Each single roll has an area of thirty-six square feet; but there will be waste in matching the pattern, so it is not safe to call a single roll more than thirty square feet, or sixty square feet for a double roll; and with patterns which are difficult to match, even this may be too much to allow for a roll. The ceiling is measured in the same way, and it must be remembered that the ceiling paper must in all cases come down on the side wall a few inches, at least two inches, not only on the ends of the pieces but also on the sides; so in putting up the first piece of ceiling paper it must be turned down on the side wall as well as at the ends of the length of paper.

Papering a Ceiling

The ceiling is always to be papered first, then the walls, and the border is put on last. Before beginning at the ceiling unroll the paper, face up, and cut it into suitable lengths, allowing enough

for the ends to turn down, and match the pattern, so that it will go on right; you cannot match the pattern after you have the paste on. Having cut and matched enough to cover the ceiling you may begin, applying the paste and trimming as has been described. In order to have the first piece on straight, it will be well to draw a straight horizontal line on the side wall about two inches below the ceiling; you may do this by driving two nails in the wall the right distance below the ceiling, one near each corner of the room, and attach a cord from one to the other; rub the cord with colored chalk or charcoal, and snap it against the wall. Then you may do the same thing on the ceiling, making the chalk-mark sixteen inches from the wall; as the paper is eighteen inches wide, it will cover the space between these two lines. One line will do; the one on the ceiling is the more convenient.

When all is ready, take the first piece of

paper, which is folded over upon itself as has been described; get up on your platform, which should be high enough so that your head is six inches below the ceiling; begin in the right-hand corner of the room (that is, the corner where, if you stand facing the wall along which the length of the ceiling paper is to go, the corner will then be at your right hand); unfold the end of the paper which you begin with, hold it over your head, and let the other end, which is still folded, hang down behind you; attach the paper to the ceiling, first with your hand, and then smooth it out with your smoothing-brush. This first piece is the most difficult in the whole job, as you have only the chalk-line for your guide, and it must come down on the wall a little. When you have got half of it on, you will unfold the other half and put it up. After that you have the edge of the last piece for your guide, and have only to look out for matching the pattern.

When the last piece is up, its edge comes down on the other side wall.

Papering the Side Wall

After you have papered the ceiling you will probably feel that you do not need any further advice about paper-hanging. The pieces of paper which you cut for the side wall should be a little longer than the height they are to cover, say four to six inches; you will of course match the paper when you cut it up, and if the pattern is large you will waste considerable paper, but that cannot be helped; often a foot in a length will be cut off and thrown away. The top will be covered with the border, so it is not important to have it even; but often no border is used, and then it is quite a particular job to have the paper cut so that the pattern matches exactly, and you will need the carpenter's square to cut the ends exactly true. The bottom will hang below the top of the base-board, and with the back of the shears you will make a

crease in the damp paper at the top of the base-board; then cut it off as thus marked.

Doors and Windows

It is usual to begin papering the wall by starting at the side of a door; this gives a vertical line, easy to fit, and makes it certain that you will have to cut paper to fit not more than one side of that door.

It is common practice for paper-hangers to begin anew at the right-hand side of each door and window, and leave the short pieces over the doors and over and under the windows to be done last; do not ever tolerate this; and if you are making a bargain with a paper-hanger always mention this point. Otherwise you will have mismatched paper at every one of these places. It takes more paper and more time to do it right, but you should consider that all you put the paper on for at all is to have it look well, and if you have got to see a botched job every day for two or three

years, — often wall-paper lasts ten years and sometimes fifty, — it pays to do it right in the first place. When you come to a window, go on and match the paper carefully over and under it, and when you get to the other side of the window probably you will have to cut a long piece in two lengthwise to bring the pattern right; but then it will be right, and you will always have the satisfaction of knowing it, and so will other people. And this leads me to say that in ordering paper, after you have made reasonable allowances for waste, it is always well to buy at least one double roll extra for just such emergencies as this, which you cannot foresee. Besides, you may spoil a piece occasionally. Paper doesn't cost much; it is the labor that counts. It is a grievous thing to have to say, however, that if you bargain with a paper-hanger to do the job and let him buy the paper for you (after you select it), as is a common custom, you must

look out that he does not leave three or four double rolls extra on your hands, merely because he gets a commission of twenty-five to forty per cent on it. Generally you can bargain to have all full double rolls taken back and have the cash returned. You may be told that you will need some extra paper for occasional repairs; well, practically you won't. It is not often that patching is done; paper begins to fade as soon as it is applied, and a new piece of the same paper used as a patch shows about as much as though it were a different paper.

Cleaning Wall Paper

It is well to know that you can sometimes clean wall-paper, especially ceilings which have become smoked; this is done with a handful of unbaked dough, to which the dirt will stick. What I always use is the moist, soft part of a loaf of fresh bread, just baked; with it a ceiling can be cleaned so as to look and be as good

as new, and it is not a difficult thing to do. Moldings and ornaments can be cleaned the same way.

In putting on the border, which is the last part of the paper-hanging, do not begin in a corner; start a few inches back from the corner, and then you can make a smooth corner job.

Whitewashing.

Whitewash is made from lime; for this purpose the lime should be in hard lumps, not such as has been long exposed to the air and become air-slaked. The U. S. Lighthouse Board recipe for making whitewash says that we may slake half a bushel of lime in boiling water, keeping it covered during the process to keep in the steam; but here it may be said that the more common practice is to put cold water on the lime, not enough to drown it, but slowly add as much as the lime will take up; it will

How to Make Whitewash

generate plenty of heat, and steam will come off; keep adding water slowly, and finally the lime will crumble and become a loose white mass, to which enough water is added to make it a paste, and this is to be stirred with a stick until it begins to cool; this indicates that it has combined with all the water it will take. Some lime is much slower about this than other, because all limestone, from which lime is made, is not of the same chemical composition. There is no objection to using hot water, which will start it more quickly. It is then thinned with water to a thin paste, and put through a strainer, as there are often lumps and dirt in it.

Now we go back to the recipe. Add to the strained lime paste a peck of salt (about fifteen pounds), previously dissolved in hot water; boil three pounds of rice to a thin paste, strain it, and stir it in while the whole is hot; have a pound of good glue dissolved

by soaking it the night before in cold water, then pour off the extra water and pour on to it three or four quarts of boiling water and stir it, and it will dissolve; in this glue solution stir half a pound of whiting (which is pulverized chalk), and add this glue and whiting mixture to the lime and salt. The glue may be dissolved without previous soaking in a large glue-pot, or in an oat-meal cooking-pot, or in a small pot hung in a larger pot filled with boiling water; but the method first described is best. After all these ingredients are stirred in, add five gallons of hot water, stir well, and let it stand for a few days, covered from dirt. It is to be applied hot. It is estimated that a pint of this mixture will cover a square yard of surface. This is undoubtedly a good whitewash. The most common whitewash is made by slaking the lime with water as described, then thinning it with more water and straining it.

It is probably not desirable to add glue to it if it is to be used in cellars, but the rice would be less objectionable; in place of rice, flour may be used, either wheat, rye, or buckwheat, but not corn meal; rice is most nearly white. The lime combines with the proteid matter of the rice or flour to make a cement, and this makes it adhere better. In some places it is the practice to thin the whitewash with sweet skim-milk; this acts in the same way and is excellent for outdoor work, as it stands the weather well; the lime unites with the casein of the milk to make a cement. This is not suitable for cellars, but is all right for dry places. Whitewash, as everyone knows, is applied with a wide, flat brush; the operator does not rub it on, as the painter does paint, but lightly brushes over the wall or ceiling with the brush so as to use the ends of the bristles, not bearing on

Extra Cementing Material

How to Apply Whitewash

enough to bend over the bristles so that a great part of their length will touch the wall. The brush is held lightly; the arm is not stiff, but bends freely at the elbow; the whole action should show flexibility and freedom. This is equally true of kalsomining, which is only a variety of whitewashing. In whitewashing a ceiling it is well for the operator to begin on the side next the windows, so as to be working away from the light.

The floor should be covered with canvas or building-paper, as lime-stains are difficult to remove. Before beginning work the wall or ceiling to be treated should be thoroughly cleaned; old whitewash should be washed off, scrubbing it with a brush if necessary; and if it is a place where the good appearance is important, as in a room, stains should be removed or covered up, as will be described under the subject of Kalsomine. Whitewash is the most purely white coating known; and

it is sanitary, as the lime has a purifying action, kills germs, and does not act as a medium for their growth. It is on this account a good coating for cellar-walls and the like, also for the interior of stables and outbuildings in general. It may be colored with any pigments which are not attacked by lime; a yellow or cream color is obtained by adding yellow ocher; it will mix with any of the iron oxides, as Venetian red or Indian red, also with umber and sienna; and tints may be obtained with mixtures of these, with or without lampblack, as described in speaking of oil paints. Bright yellow and green cannot be made, but various dull colors are available. However, whitewash is generally white; and although the directions of the U.S. Lighthouse Board say to apply it hot, that is intended to apply only to the rather complex mixture which they recommend; common whitewash

Colors for Whitewash

is used cold. It is not unusual to put a little carbolic acid in it for use in cellars, stables, and the like.

Whitewash brushes should be washed out immediately after using, as the caustic lime is not good for them. To determine how thick whitewash should be, it is customary to brush out a little of it on a piece of well-sized paper, which can be dried quickly; this will show if it covers sufficiently; if it is too thick the coating will look coarse and sandy.

Testing

Kalsomining.

Kalsomine, or calcimine, is much like whitewash; it is a water-paint, having a lime as a base; but whereas whitewash is a mixture of fresh, caustic water-slaked lime with water, and has enough adhesive quality to make it stick by itself fairly well, kalsomine is made of the carbonate of

Kalsomine: How Made

lime, or chalk ground to a fine powder and known as whiting, Paris white, or Spanish white, mixed not with pure water but with size, or a thin solution of glue, which is the binder. To make it, fifteen or twenty pounds of whiting are mixed with water enough to make a thick paste; half a pound of good white glue, which has previously been dissolved in water by the method already described, is added to it, and enough hot water is then added to make about one-fifth as many gallons as there are pounds of whiting; that is, five pounds of whiting make a gallon of kalsomine. When cool it will be a jelly, and is then ready for application. If it is desired to have it tinted, the color must be mixed with enough water to make a thin fluid and added to the whiting before the glue is added; at least, this is the best way, though it is often put into the hot kalsomine after it is finished, because then the color may be judged by painting out a little

on a piece of paper and drying it. The color is darker when wet, and can only be judged when dry. At the same time the operator can tell if enough glue has been put in so that the kalsomine will not rub off; different kinds of glue differ in strength. If a pure white is desired, it is not uncommon to add a little ultramarine, to correct the slightly yellowish tint which would otherwise be present.

Kalsomine is applied with a wide brush, like whitewash; and if the wall is stained, it must be treated in some way to remove or cover up the stain; this is like the preparation for whitewashing. First remove all old kalsomine, whitewash, or paper; then wash the wall well with soda solution, then with clean warm water; if any stains remain they may be covered with a coat of shellac varnish; many advise painting the whole surface with an oil paint, the only objection to which is

Preparation of Wall

its cost and the time required. I have found an efficient covering for spots to be a coat of aluminum paint, which is nearly white, absolutely opaque, dries quickly, and adheres to anything, but is rather costly except for small spots. If it is used, it should be the sort which has a pungent smell of bananas; aluminum paint is sometimes made with a rosin size, which is not so good.

After "killing" the stains, it is usual to apply a coat of size to the wall, as if for papering; this keeps the kalsomine from striking in and being spotty. A soap and alum size is also recommended; enough soap is dissolved in hot water to be, when cold, a jelly, and this is rubbed well into the wall with a stiff brush; after a day's drying a solution of alum, a pound to a gallon of water, is applied in liberal quantity; this makes an insoluble alum soap; and this should be allowed a day to dry.

Since the lime in kalsomine is in the form of carbonate, and not caustic, it is possible to use a wide range of pigments to obtain color effects. After the wall or ceiling has been kalsomined, it is possible to decorate it with figures or borders, using, as paint, kalsomine of suitable colors; this is called frescoing. The English name for this kind of paint is distemper; and these fresco or distemper paints are often sold in bottles or jars ready for use, containing some preservative to prevent decomposition of the glue or other binding materials.

Fresco; Distemper

Kalsomine is sold, ready mixed, in packages; these are emptied into hot water, stirred until the glue is dissolved, then allowed to cool before using.

Recently kalsomine has been put on the market which dissolves in cold water and is ready to use at once; this is very convenient and satisfactory. A much greater variety of

color effects can be had with kalsomine than with whitewash, and it has a softer and smoother appearance, free from the somewhat rough and sandy look of whitewash, especially when put on a little too thick; but it has not the antiseptic qualities of the latter. Whitewash costs almost nothing; it is sanitary, easily applied, may be so made as to resist the weather tolerably well, and is and always will be the paint for the million. Kalsomine is used almost solely for its artistic effect, in which it is equaled only (if at all) by the most costly enamel painting. On plain work it is easily applied, but it also lends itself to display the highest skill of the artist. Some of the most celebrated pictures in the world are fresco paintings.

Cold-Water Paints.

These are related both to whitewash and to kalsomine; to the former because they contain quicklime, and to the latter because they contain a glue-like cementing material. The cement is casein which is obtained from milk. Milk consists of water, sugar, casein, and fat (butter), the last three in about equal proportions. When the butter is removed the casein may be precipitated, purified, and dried, and it is on the market as a white powder, soluble in a solution of any alkali in water. In the early days of cold-water paints borax was used; but this was a failure, because the compound formed by it and casein was not altogether insoluble when dry. Now the casein is mixed with lime; when water is added to this mixture the casein first dissolves in the lime-water, then it com-

Casein

bines chemically with more lime, and this lime and casein compound, when dry, is insoluble and is a cement of considerable strength. As the paint is put up in dry form, it is a powder containing, like kalsomine, whiting and coloring matter, and the proper amount of casein and powdered quicklime, the latter two taking the place of the glue in kalsomine.

Casein and lime cement has long been known; it has been used as a cement for crockery and the like. The directions formerly given (before the modern methods for making casein were invented) were to knead and wash cheese with water until all the fat was removed and the residue was white and crumbly; mix this with cream of lime (lime slaked and mixed with enough water to be of the consistence of cream) enough to make a paste; apply at once. This makes a very strong and water-proof cement. The casein now made is prepared in a very

Casein Cement

different way, and is chemically a somewhat different substance; but it makes a cement with lime, and resists water well. The paint thus made is practically incombustible; casein may be destroyed by fire, but it is, when dry, a substance much like glue, and can hardly be regarded as combustible; and the lime and pigment are not at all so. It offers a sensible resistance to fire. It is not washed off by rain, and is in that sense weather-proof; but it is of an open and porous structure, and does not prevent moisture from reaching the surface to which it is applied. As it contains free lime, like white-wash, it is impracticable to get such a variety of colors, or such brilliant or delicate ones, as with kalsomine; moreover, it is of a coarse texture, as compared with the latter, and is not as suitable for interior work. It is liable to mold and to decomposition if used in very damp places, as in cellars and the like.

Use of Casein Paint

Some three and a half centuries ago, Vasari, a celebrated writer and fresco painter, in his "Lives of the Painters" told the story of a painter named Paolo Ucelli, who was employed to decorate with mural paintings the walls and ceilings of some public rooms in a monastery. In addition to certain small daily wages he was provided with board and lodging; but the thrifty monks, though they themselves had an ample diet, kept him for the most part on soup and bread and cheese. He was practically a prisoner; but one day he ran away, and for a long time eluded the pursuit of the monks, who, being fat and well-fed, were easily out-run by the thin and long-legged artist. But they hit on the device of sending in pursuit some of the young men who had recently come to the monastery to prepare for admission, and they at length captured him and brought him back. When reproached with his breach of contract he explained that as

he was working with lime-washes and paints and living on cheese, he feared and indeed believed that he had symptoms that he was turning into cement. So to get the pictures done they had to give him a more varied supply of food.

APPENDIX

STANDARD FORMULAS FOR PAINTING WITH WHITE LEAD AS A BASE

(See p. 19.)

TABLE A. — NEW, UNPAINTED WOOD OUTSIDE.

Ingredients	Priming Coat	Second Coat	Third Coat
Paste white lead	100 pounds	100 pounds	100 pounds
Pure raw linseed oil	4 gallons	1½ gallons	3½–4½ gallons
Pure turpentine	2 gallons	1½ gallons	1 pint
Drier free from rosin	1 pint	1 pint	1 pint
How much paint it makes	9 gallons	6 gallons	6½–7½ gallons
Square feet it will cover	5175 sq. ft.	3600 sq. ft.	3900–4500 sq. ft.

TABLE B. — FOR REPAINTING OLD WOOD OUTSIDE.

Ingredients	First Coat	Second Coat
Paste white lead	100 pounds	100 pounds
Pure raw linseed oil	2 gallons	3½–4½ gallons
Pure turpentine	2 gallons	1 pint
Drier free from rosin	1 pint	1 pint
How much paint it makes	7 gallons	6½–7½ gallons
Square feet it will cover	4200 sq. ft.	3900–4500 sq. ft.

TABLE C. — QUANTITIES OF EACH MATERIAL REQUIRED FOR MIXING ONE GALLON OF PAINT.

(NEW WORK [WOOD] OUTSIDE.)

Ingredients	Priming Coat	Second Coat	Third Coat
Paste white lead	11 pounds	16⅔ pounds	14¼ pounds
Pure raw linseed oil	4 pints	2 pints	4½ pints
Pure turpentine	1⅓ pints	2 pints	⅛ pint
Drier free from rosin	⅓ pint	⅛ pint	⅛ pint
Square feet it will cover	575 sq. ft.	600 sq. ft.	600 sq. ft.

(OLD WORK [WOOD] OUTSIDE.)

Ingredients	First Coat	Second Coat
Paste white lead	14¼ pounds	14¼ pounds
Pure raw linseed oil	2¼ pints	4¼ pints
Pure turpentine	2¼ pints	⅛ pint
Drier free from rosin	⅛ pint	⅛ pint
Square feet it will cover	600 sq. ft.	600 sq. ft.

TABLE D. — NEW INTERIOR WOODWORK.

Ingredients	Priming Coat	Second Coat	Third Coat, Oil-Gloss Finish
Paste white lead	100 pounds	100 pounds	100 pounds
Pure raw linseed oil	3 gallons	1½ gallons	3–3½ gallons
Pure turpentine	4 gallons	1½ gallons	2 pints
Drier free from rosin	1½–2 pints	1 pint	1–1½ pints
How much paint it makes	10 gallons	6 gallons	6–6½ gallons
Square feet it will cover	5750 sq. ft.	3600 sq. ft.	3600–3900 sq. ft.

Ingredients	Third Coat, Egg-Shell Gloss Finish	Third Coat, Flat Finish
Paste white lead	100 pounds	100 pounds
Pure raw linseed oil	3 pints	1 pint light enamel varnish
Pure turpentine	2 gallons	3 gallons
Drier free from rosin	½ pint	½ pint
How much paint it makes	5¼ gallons	6 gallons
Square feet it will cover	3150 sq. ft.	3600 sq. ft.

TABLE E. — INTERIOR WOODWORK.

Ingredients	First Coat	Second Coat, Oil-Gloss Finish
Paste white lead	100 pounds	100 pounds
Pure raw linseed oil	1 gallon	3–3½ gallons
Pure turpentine	2 gallons	2 pints
Drier free from rosin	1 pint	1–1½ pints
How much paint it makes	6 gallons	6⅛–6¾ gallons
Square feet it will cover	3600 sq. ft.	3675–4050 sq. ft.

Ingredients	Second Coat, Egg-Shell Gloss Finish	Second Coat, Flat Finish
Paste white lead	100 pounds	100 pounds
Pure raw linseed oil	3 pints	1 pint
Pure turpentine	2 gallons	2 gallons
Drier free from rosin	½ pint	½ pint
How much paint it makes	5¼ gallons	5 gallons
Square feet it will cover	3150 sq. ft.	3000 sq. ft.

TABLE F. — DRY (NOT FRESH) PLASTER WALLS.

Ingredients	Priming Coat	Second Coat	Third Coat, Oil-Gloss Finish
Paste white lead.....	100 pounds	100 pounds	100 pounds
Pure linseed oil.....	7 gallons boiled oil	1½ gallons raw oil	3 gallons (raw)
Pure turpentine.....	1 gallon	1½ gallons	1 gallon
Drier free from rosin	None	1 pint	1 pint
How much paint it makes	11 gallons	6 gallons	7 gallons
Square feet it will cover.	6325 sq. ft.	3600 sq. ft.	4200 sq. ft.

Ingredients	Third Coat, Egg-Shell Gloss	Third Coat, Flat Finish
Paste white lead.....	100 pounds	100 pounds
Pure linseed oil.....	1 gallon (raw)	1 pint light enamel varnish
Pure turpentine.....	2½ gallons	2½ gallons
Drier free from rosin	½ pint	½ pint
How much paint it makes.....	6½ gallons	5½ gallons
Square feet it will cover.....	3900 sq. ft.	3300 sq. ft.

Formulas for U. S. Army Colors.

O. D. (olive drab) or khaki color.

Olive Drab

25½ pounds French ocher in paste
5½ pounds paste lampblack
15½ pounds chrome green medium in paste
5 gallons raw linseed oil
1 pint turpentine
1 quart drier

Medium Drab

25 pounds paste white lead
11 pounds French ocher
2½ ounces paste lampblack
2½ gallons raw linseed oil
½ pint turpentine
1 pint drier

Light Drab

25 pounds French ocher
1 ounce lampblack
3⅔ gallons raw linseed oil
½ pint turpentine
⅔ pint drier

Formulas for Making Tinted Paint.

To 100 pounds of paste white lead ground in oil add colors-in-oil as directed. The tinting colors are called "colors-in-oil" and may be obtained from any dealer who handles painting materials. The colors should be added to the white lead before the paint is thinned.

1 — *Medium Blue Slate*
14 oz. lampblack

2 — *Light Gull Gray*
1 oz. lampblack

3 — *Light Gray (blue cast — lighter than No. 2)*
½ oz. lampblack

4 — *Dark Drab*
22 lbs. French ocher
2 lbs. lampblack
1 lb. Venetian red

5 — *Doe Color*
2 lbs. 4 oz. French ocher
9 oz. lampblack

6 — *Smoke Gray*
2 lbs. 4 oz. French ocher
5 oz. lampblack

7 — *Gray Blue*
1 oz. lampblack
3 oz. Prussian blue
1 lb. 1 oz. medium chrome green

8 — *Robin's Egg Blue*
½ oz. lampblack
¼ oz. Prussian blue

9 — *Light Blue*
¼ oz. lampblack
⅛ oz. Prussian blue

10 — *Dark Lilac*
4 oz. lampblack
1 lb. 2 oz. Venetian red

11 — *Lilac*
2 oz. lampblack
6 oz. Venetian red

12 — *Pale Lilac*
- ½ oz. lampblack
- ¾ oz. Venetian red

13 — *Dark Slate*
- 7 oz. lampblack
- 11 oz. medium chrome yellow

14 — *Light Olive Gray*
- 3 oz. lampblack
- 5 oz. medium chrome yellow

15 — *Pale Olive Gray*
- 12 oz. French ocher
- 5 oz. lampblack

16 — *Deep Claret*
- 31 lbs. French ocher
- 4½ oz. lampblack
- 61 lbs. English Tuscan red

17 — *Salmon Pink*
- 2 lbs. 10 oz. Venetian red

18 — *Light Coral Pink*
- 14 oz. Venetian red

19 — *Earth Brown*
- 32 lbs. French ocher
- 1 lb. 8 oz. lampblack
- 2 lbs. 5 oz. Venetian red

20 — *Grayish Tan*
- 2 lbs. 3 oz. French ocher
- 1½ oz. lampblack

21 — *Mushroom*
- 1 lb. 2 oz. French ocher
- ½ oz. lampblack
- $\frac{5}{10}$ oz. Venetian red

22 — *Forest Green*
- 7 oz. lampblack
- 54 lbs. light green
- 2 lbs. 4 oz. medium chrome yellow

23 — *Dark Ivy Green*
- 3¾ oz. lampblack
- 1 lb. 5 oz. light green
- 2 lbs. 6½ oz. medium chrome yellow

24 — *Dark Greenish Olive*
- 1½ oz. lampblack
- 1⅞ oz. light green
- 13 oz. medium chrome yellow

25 — *Tea Green*
- 2 lbs. lampblack
- 9 lbs. 2 oz. medium chrome green
- 4 lbs. 10 oz. medium chrome yellow

26 — *Light Gray (yellow cast)*
- 16 oz. lampblack
- 4 lbs. 10 oz. medium chrome yellow

27 — *Olive Buff*
½ oz. lampblack
6¾ oz. medium chrome yellow

28 — *Cafe au Lait*
6 lbs. 2 oz. French ocher
2½ oz. lampblack
13 oz. Venetian red

29 — *Light Pinkish Cinnamon*
2 lbs. 3 oz. French ocher
½ oz. lampblack
4¼ oz. Venetian red

30 — *Light Fawn*
10 oz. French ocher
⅝ oz. Venetian red

31 — *Dull Olive*
1 lb. 6 oz. lampblack
4 lbs. 9 oz. medium chrome green
4 lbs. 10 oz. medium chrome yellow

32 — *Mineral Gray*
3 oz. lampblack
14 oz. lemon chrome yellow

33 — *Pearl Gray*
¾ oz. lampblack
2½ oz. medium chrome yellow

34 — *Buff*
5 lbs. 12 oz. French ocher
¾ oz. Venetian red

35 — *Cream*
2 lbs. 1 oz. French ocher

36 — *Light Cream*
7 oz. French ocher
5 oz. medium chrome yellow

37 — *Yellow Tan*
10 lbs. 15 oz. French ocher
4½ oz. lampblack

38 — *Pale Yellow*
7 oz. medium chrome yellow

39 — *Dark, Dull, Yellow Green*
2 lbs. 1 oz. lampblack
18 lbs. 10 oz. medium chrome green
6 lbs. 9 oz. medium chrome yellow

40 — *Tan*
6 oz. French ocher
¾ oz. lampblack
4½ oz. Venetian red

41 — *Indian Red*
Indian red only

42 — *Gray Stone*
12 oz. French ocher
1 oz. lampblack

43 — *Pearl*
8 oz. French ocher
½ oz. lampblack

44 — *Yellow Brown*
7 lbs. 8 oz. French ocher
1 oz. lampblack

45 — *Sea Green*
1½ oz. lampblack
2 oz. medium chrome green
5 oz. medium chrome yellow

46 — *Pale Greenish Gray*
$\frac{2}{10}$ oz. lampblack
$\frac{5}{10}$ oz. Prussian blue
$\frac{2}{10}$ oz. lemon chrome yellow

47 — *Brownish Gray*
2 oz. lampblack
4 oz. Venetian red
9 oz. medium chrome yellow

48 — *Neutral Gray*
1 lb. 1 oz. French ocher
5 oz. lampblack
$\frac{4}{10}$ oz. Venetian red

49 — *Buttercup Yellow*
5 oz. French ocher
8 oz. medium chrome yellow

50 — *Quaker Drab*
2 lbs. 12 oz. French ocher
3 oz. lampblack

51 — *Ash Gray*
8¼ oz. French ocher
1⅛ oz. lampblack

52 — *Ivory Yellow*
1 oz. medium chrome yellow

53 — *Gray Green*
½ oz. lampblack
4 oz. medium chrome yellow
4½ oz. lemon chrome yellow

54 — *Pea Green*
4 oz. lampblack
12½ oz. medium chrome yellow
2 lbs. 1 oz. medium chrome green

55 — *Clam Shell White*
1 oz. Prussian blue
½ oz. lemon chrome yellow

56 — *Greenish Turquoise*
1 oz. lampblack
2 oz. medium chrome yellow
1 oz. Prussian blue
1 lb. 1 oz. medium chrome green

57 — *Lemon Yellow*

$\frac{3}{10}$ oz. lampblack
$3\frac{8}{10}$ oz. medium chrome yellow
1 lb. $\frac{8}{10}$ oz. lemon chrome yellow

58 — *Deep Cream*

2 lbs. 15 oz. French ocher

59 — *Silver Green*

4–10 oz. Prussian blue

60 — *Light Gray*

$\frac{4}{10}$ oz. lampblack
2 oz. medium chrome yellow

61 — *Light Grape Green*

$\frac{1}{2}$ oz. lampblack
$12\frac{1}{2}$ oz. medium chrome yellow
14 oz. medium chrome green

62 — *Light Chestnut*

12 lbs. $7\frac{8}{10}$ oz. French ocher
1 lb. 1 oz. lampblack
2 lbs. 4 oz. Venetian red

63 — *Delft Blue*

3 oz. lampblack
1 lb. $6\frac{1}{2}$ oz. Prussian blue
1 lb. 2 oz. medium chrome green

64 — *Pale Flesh Color*

$1\frac{1}{2}$ oz. medium chrome yellow
4 oz. Venetian red

65 — *Old Gold*

5 lbs. 9 oz. French ocher
$\frac{2}{10}$ oz. lampblack

66 — *Light Delft Blue*

3 oz. Prussian blue
7 oz. medium chrome green

67 — *Nile Blue*

1 oz. Prussian blue
$\frac{1}{2}$ oz. lemon chrome yellow

68 — *Light Brown*

5 lbs. 9 oz. French ocher
$1\frac{8}{10}$ oz. lampblack
$4\frac{2}{10}$ oz. Venetian red

69 — *Pale Dull Blue*

1 oz. Prussian blue

70 — *Lavender Gray*

5 oz. Venetian red
1 oz. Prussian blue

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